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WITH THE ASSISTANCE OF

GENTLEMEN EMINENT IN SCIENCE AND LITERATURE.

IN EIGHTEEN VOLUMES.

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POLAR REGIONS.*

A GENERAL designation for those parts of the globe, included within the arctic and antarctic circles, and consequently occupying a space, circumscribed by a circle of 23½ degrees of latitude around each pole.

The general want of inhabitants, and the deficiency of those products suited for the necessities of human beings, intimate that the polar regions were not designed for the permanent residence of man. In a few instances, indeed, the flexibility and hardihood of constitution which enable our species to endure the extremes of heat and cold that occur in the torrid and *frigid* zones, have also been the means of peopling, to a small extent, some of the sterile tracts of the arctic lands. Thus we find those hardy people the Esquimaux, Samoides, Laplanders, Tchutkchi, and a few northern Indians occupying, in scattered hordes, the otherwise desolate and Arctic portions of America, Europe, and Asia. Many of these people are so far distinct in their habits from the rest of the human race, that they live almost entirely upon animal food, and in their subsistence differ only from carnivorous animals in the cooking, or partial cooking, to which their provision is subjected before it is made use of. These scattered tribes, which appear to belong to some branch of the ancient *Tartar stock*, are confined to the Arctic regions, or the immediate neighbourhood.

Antarctic regions.

The Antarctic regions, as far as we yet know, and have reason to believe, are entirely destitute of human inhabitants. None of the southern lands, indeed, within ten degrees of the Antarctic circle, yet discovered, have been found to be peopled. Those extensive tracts the Sandwich Land, and its probable continuation South Shetland, do not appear to afford a residence to a single human being; nor have the whole of the regions within the Antarctic circle, and for the next ten degrees of latitude nearer to the equator, as far as can be ascertained, ever afforded, excepting to a few adventurous fishermen, any produce, wealth, or subsistence to mankind.

With regard to the southern polar regions little however is yet known; the tracks of few navigators have extended to the Antarctic circle, and no land, except two desolate islands, has yet been discovered within it. The *Terra Australis* of early geographers is either wholly a place of imagination; or securely enveloped, probably beyond the reach of mortals, within the vast and impermeable expanse of the Antarctic ices. Captain Cook (until a recent expedition by the Russians, noticed in the appendix) was the only voyager who made any considerable advance within the southern frigid zone; thrice he penetrated its limit, but observed no object of any interest, excepting the prodigious *fields* and *islands* of ice by which his further progress was prevented. He first crossed the Antarctic circle on the 17th of Jan. 1773, on the meridian of about 40° east, and advanced into the southern frigid zone, which had hitherto remained impenetrable to all navigators. He again accomplished a similar advance towards the pole on the 20th of Dec. following, in longitude 147° 30′ west, when the sun at midnight was for the first time exhibited to human observation within the southern hemisphere. And on the 30th of January, 1774, he attained the latitude of 71° 10′ 30″ south, being the nearest approach to the southern pole ever effected.

SECT. I.—*Progress of Discovery in the Polar Regions.*

Our information respecting the Antarctic regions is so entirely destitute of interest, and is at the same time so extremely limited, that we shall take a hasty leave of them, and confine ourselves chiefly to a *view of the North Polar regions*, respecting which we have much more ample information. Curiosity and self-interest, the two fruitful stimuli to investigation and research, have, we believe, been the occasion of almost all those great geographical discoveries which have not been merely accidental. To the influence of one or both of these motives, the whole of the discoveries made within the Arctic circle may be safely attributed.

Ohthere, a Norwegian of the ninth century, a man of enterprise and wealth, instigated, it would appear, by the first of these motives, curiosity, undertook a coasting voyage from Drontheim towards the north, and was the first adventurer, of whom we have any account, who crossed the Arctic circle: his voyage extended beyond the North Cape of Norway to the entrance of the White Sea. Iceland was discovered by a Scandinavian pirate about the same period; and the south of Greenland was discovered about the year 970, by one of the colonists of Iceland. But these are tracts of country which lie without our limits, excepting a small promontory of the former, and the northern continuation of the latter.

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* The Editor has been indebted for this interesting article to WILLIAM SCORESBY, Esq. jun. F. R. S. &c.

The popular idea of a northern passage to India,—which was suggested by John Vaz Costa Cortereal, or according to a more general opinion, by John Cabot, the father of the celebrated Sebastian Cabot, about the middle, or latter end of the fifteenth century,—was the occasion of a number of voyages being undertaken into the Arctic Sea, from which, with some considerable discoveries made by the whale-fishers, almost the whole of our knowledge of Arctic lands has been primarily derived.

Though many attempts were made to find a north-western or western passage to India before the middle of the sixteenth century, there is no well-authenticated account of any of these voyagers having extended their researches within the Arctic circle. Sir Hugh Willoughby, therefore, who discovered *Nova Zembla* in the year 1553, and perished soon afterwards with the crews of two ships, on attempting to winter in Lapland, may be considered as one of the first discoverers within the frigid zone. He was succeeded by Stephen Burrough, who discovered the island of Weigats, and visited Nova Zembla; and by Frobisher and several others in voyages towards the north-west, whose researches did not extend so far as the polar circle. John Davis, however, passed this circle in the year 1585, and in the course of this and subsequent voyages discovered the strait named after him, and the greater part of the coast on both sides of Davis's Strait, as high as the latitude of 72° 12′ north. William Barentz, a Dutch navigator, discovered Spitzbergen, together with Bear or Cherie Island, in the year 1596, the investigation of the coasts of which, as far almost as at present known, was completed by the English whalers between 1611 and 1620. The first land seen within the Arctic circle, on the east coast of Greenland, was by Henry Hudson, in 1607, who discovered *Young's Cape, Hold with Hope*, and other lands as high as latitude 73°. In Hudson's fourth voyage, in which he discovered the strait and bay distinguished by his name, this brave navigator was forced by a mutinous crew into a boat, and, with eight of his adherents, abandoned to perish. The celebrated William Baffin, in the year 1616, discovered the bay bearing his name, and circumnavigated, in a solitary little vessel, this extensive and ice-encumbered sea, into which the most adventurous navigators have not ventured to follow him until within the present century.

Considerable navigations of the Frozen Sea, on the northern face of Asia and Europe, were made by the Russians in 1636 and the ten following years, in which establishments were formed on the banks of the Lena, &c.; and the rivers Jana, Indighirsa, Alasei, Kovima, &c. were discovered. The celebrated, but still doubtful voyage of Semoen Deschnew, round the great promontory of the Tchuktchi, to the east side of Kamtchatka, was undertaken in the year 1648 from the Kovima; and the discovery of Behring's Strait by the navigator of that name, was accomplished in 1728. This strait has since been passed by Capt. Cook, who reached the latitude 70° 44′, the highest ever attained in that region, in the summer of 1778. Capt. Clerke, the successor of this extraordinary navigator, in 1779, Joseph Billings, in 1790, and Lieut. Kotzebue, in 1816, all passed Behring's Strait; but none of them reached the extent to which Cook attained. Subsequently, however, in an investigation by land, Capt. Cochrane, we understand, has traced the whole of the Tchuktchi Noss, and determined its peninsularity.

The greater part, almost the whole indeed, of the northern coast of Russia, between Archangel and the Tchuktchi Noss, was traced by interrupted detail in the years 1734 to 1740 by the Russians; and some other researches since that period, have been accomplished by the same nation in the Frozen Sea.

The journey of Hearne to Copper-mine River in 1772, and of Alexander Mackenzie in 1789 to the Frozen Ocean, bring us down to the period of the recent voyages of Captains Ross and Parry towards the north-west, and of the overland expedition of Capt. Franklin. Some of the whale fishers frequenting Davis' Strait, penetrated in the year 1817 to an unusual height into Baffin's Bay; and some of the Spitzbergen whalers also penetrated to within sight of the ice-bound coast of East Greenland. This uncommon permeability of the polar ices, with a representation of one of the captains that a great quantity of ice had disappeared out of the polar seas, and that circumstances were very favourable for discovery, was the occasion, we believe, of the recent voyages having been undertaken. Captain Ross, in the year 1818, circumnavigated the Bay of Baffin, corrected its geography, and expunged from the maps the supposed land lying in the centre of the straits, called James's Island. As the time allowed to Captain Ross did not permit him to complete the examination of this bay, and as there appeared to the government some reason to believe, that Lancaster Sound of Baffin was an outlet into the Hyperborean Sea, Captain Parry, well provided for wintering in these seas, was sent out the year following for the purpose of pursuing this supposed opening, and determining its limits towards the west. This was accomplished in the ablest manner; no particular difficulty indeed occurred, until the expedition reached the longitude of 110° west, but coming then on the coasts of a large island, which was named Melville Island, the ice was found gradually to approach, and ultimately to form a junction with the shore. After every exertion, and after exposing the ships to considerable risk, advanced to the longitude of 112° 51′ west, in latitude 74° 22 north, where the ice became an impervious wall. The winter now beginning to set in, they returned a few leagues to the eastward to a secure place in Melville Island, which they named Winter Harbour, where they remained in great quietness and safety, firmly frozen up until the middle of the next summer. Being fairly released on the 1st of Aug. 1820, they renewed the attempt to penetrate to the westward; but after pressing with uncommon perseverance between the ice and the coast, in a dangerous and dubious channel, as far as longitude 113° 46′ 43″ west, (in latitude 74° 26′ 25″,) they found it impracticable to proceed farther and therefore returned to search for a more favourable situation for pursuing the investigation. In this, however, they were not successful, the ice forming a barrier to the westward wherever they went. They arrived in England in the beginning of November, after having penetrated 520 miles, or 32¼° of longitude farther to the westward than any former navigator in this parallel, and discovered various barren islands extending from

Lancaster Sound to Melville Island. To the chain of islands they met with on the north side, which were nearly continuous, the occurrence of the open sea, (wherein they made such considerable progress to the westward) is to be attributed. This uncommon degree of success called for further research; and Capt. Parry, whose judicious management of the people under his charge, whose persevering zeal in the cause had distinguished him as admirably calculated for such a service, was accordingly dispatched again on a similar service, and in a state of the best possible equipment, on the 8th of May, 1821. He returned safely in the month of October, 1823, after two years and a half spent in laborious though fruitless exertions to obtain a passage through the northern part of Hudson's Bay, round the north-eastern extremity of the American continent.

Captain Franklin, in his over-land expedition to the mouth of the Copper-Mine River, obtained the first accurate knowledge of the American coast of the Frozen Sea. His researches were perfectly satisfactory, as far as they extended; and it was owing only perhaps to some unfortunate contingencies, and to the extreme hardships he encountered, that the complete design of his laborious adventure did not fully succeed; for certainly, as much was accomplished as human perseverance could encounter.

A portion of the eastern side of Greenland, lying between the parallels of 72° and 73° north, we have observed, was discovered by Henry Hudson in the year 1607; but we have no record of any person having ever landed upon this coast, except Captain Scoresby, Jun. nor have we any details concerning it, excepting what we derive from the journal and researches of this navigator.* Captain Scoresby, in his annual visits to the Greenland whale fishery, has at different times obtained sight of this coast, which for centuries was supposed to be confined within an impenetrable zone of ice. In the summer of 1822, however, the first opportunity for minute research, compatible with the leading designs of his voyage, occurred. He penetrated the ice to an extent of 150 miles towards the west, as soon as it was possible to accomplish a passage. On the 7th of June he saw land (the east coast of Greenland) in the parallel of 75°, and remained generally within sight of it until the 26th of August. During this interval Captain Scoresby, notwithstanding the arduous duties of his profession, and the want of proper assistance for such a work, accomplished a survey of nearly the whole line of coast from latitude 75° to 69°, consisting of an extent, including the various indentations and flexures, of near 800 geographical miles.† By this survey, it was found that the coast was in general so totally unlike what it is represented to be in our best charts, both as to form and position, that the greater part of the land he visited and explored may safely be considered as a new country. Various islands and inlets were discovered, and names were given to the most striking parts of the coast. One of the inlets was penetrated and examined by Capt. Scoresby, with the assistance of his father, to the depth of fifty or sixty miles. Capt. Scoresby's researches towards the south were limited by the leading objects of the voyage, otherwise he had no doubt of being able to proceed along shore betwixt the land and the ice, had he had a justifiable motive, down to Cape Farewell, and had every prospect of being able to determine the fate of the ancient Norwegian colonies, respecting which there is such a general and intense interest.

Having now briefly traced the progress of geographical discovery within the Arctic circle, we shall conclude this division of our article with a notice of the highest advances made towards the north pole.

The first attempt to reach the north pole, of which we have any account, was undertaken about the year 1527, at the suggestion of one Robert Thorne, of Bristol, who proposed the scheme of the trans-polar passage for shortening the voyage to India. The result of this attempt is not known. After this voyage, the passage across the pole was successively attempted by Barentz in 1596, Hudson in 1607, Jonas Poole in 1610 and 1611, Baffin and Fotherby in 1614, Fotherby in 1615, Phipps in 1773, and Buchan in 1818.

The highest latitude attained by any of these navigators, it would appear, did not exceed 81°. Probably Phipps, who penetrated to 80° 48′, was the nearest to the pole. Some of the whalers, however, who pursue the *Mysticetus* in these frozen regions, have proceeded still farther north. Daines Barrington, in his discussion of the question respecting "the probability of reaching the north pole," gives a number of instances of whalers having attained higher latitudes than Phipps by several degrees. But as his information was derived entirely from oral communications, there is reason to believe that most of his examples were greatly exaggerated by the persons from whom he derived them. The closest approximation to the pole that is fully authenticated, was doubtless that of Captain Scoresby, Sen. who, in the year 1806 penetrated the northern ice, a single ship, as high as 81° 30′ north.‡

The whale-fishers almost annually sail to the latitude of 80°, or 80½°; but the extent reached by Capt. Scoresby, Sen. is very rarely attainable.

With a view of encouraging advances towards the pole, government has for some years held out a scale of rewards for navigators penetrating to certain latitudes; but as the first premium is offered for 83°, a latitude much too high for the commencement of the scale, it does not appear to have produced a single energetic attempt.

From the great severity of the cold in the regions beyond the 80th parallel, the mean annual temperature being perhaps 20° below the freezing point, combined with the observations and experience of many years, Captain Scoresby, Jun. is of opinion, that the field ice met with in so great profusion around Spitzbergen extends (provided there be no land) continuously to the pole. Hence he conceives, that the only access to the pole would be over the ice; and he several years ago gave a memoir on the subject of the practicability of accomplishing the journey on sledges, drawn by dogs or rein-deer. The feasibleness of the plan he grounds on several examples of considerable journeys having been performed in this manner over snow-clad land, and also across extensive surfaces of ice, which in patches, occupy the various clefts in the sides of the hills, cap the mountain summits, or fill with extended beds and mighty glaciers the most considerable valleys. There is, indeed, a kind of majesty not to be conveyed in words, in these extraordinary accumulations of snow and ice in the valleys, and in the rocks above rocks and peaks above peaks in the mountain groups, which appear above the ordinary elevation of the clouds, and extend to the utmost limit of vision; and when you approach the shore under the impenetrable obscurity of a summer fog, and the fog happens to disperse, as is often the case like the drawing of a curtain, then these interesting lands, exhibiting a strong contrast of light and shade, heightened to the utmost extent by a cloudless atmosphere and powerful sun, burst on the senses in a brilliant exhibition, resembling the production of magic.[*]

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* *Journal of a Voyage to the Northern Whale Fishery*, in 1822.

† The laborious nature of this work may be judged of, from the circumstance that Captain Scoresby's survey was founded on about 500 bearings or angles, besides 200 or 300 more for the deviation and variation of the compass, and that these were taken at 50 different stations, mostly determined astronomically.

‡ Scoresby's *Arctic Regions*, vol. i. 42.

To this strong contrast of the light reflected from the snow, and the deep shade of the dark coloured rocks, is to be attributed a remarkable deception observed in the apparent distance of the land. Any strangers, however well acquainted with other countries, must be completely at a loss when making the first attempt to estimate the distance of any of the bold Arctic lands. When at the distance of twenty miles, it would be no difficult matter, in situations where the deception is the most considerable, to induce even a judicious stranger to undertake a passage in a boat, from a belief that he was within a league of the shore. At this distance indeed of twenty miles, the portions of rock and patches of snow are as distinctly and strongly marked as would be expected at a fifth part of the same distance.[†]

From the great height of these lands, and the brilliant manner in which the mountains are sometimes illuminated, many of the coasts may occasionally be seen at the distance of fifty or sixty miles; and some particular mountains fully double this distance. In such cases, any extensive snow-clad surface shines with the brightness of the full moon, and exhibits a colour and appearance very similar to the resplendent face of that luminary.

SECT. III.—*Hydrography.*

We are little acquainted with the hydrography of the polar regions in general, as the greater part of the surface of the sea is covered by an impenetrable body of ice. With respect to the Greenland sea, however, which forms the most considerable proportion of the navigable part of the frigid zone, we are tolerably familiar; and also with that of Davis' Strait and Baffin's Bay. The Greenland Sea includes the whole extent between Greenland and Nova Zembla, a breadth of 1400 miles, and from the parallel of Cape Farewell to an unknown distance towards the pole. In this sea the nearest approaches to the pole are made.

The Arctic seas are less salt than those of other regions. The average specific gravity of tropical seas is about 1.0288,[‡] and of the Greenland sea about 1.0265.[§] The average quantity of saline matter in the latter is about 3.68 per cent. The difference in the saline contents of the Arctic and tropical seas is very trifling: the general uniformity may be attributed to the perpetual circulation by currents which takes place in the waters of the main ocean. In more confined seas, however, where the same exchange of waters does not take place, we find the specific gravity greatly reduced. Thus, while the lowest specific gravity observed by Mr. Scoresby in the Greenland sea was 1.0254, which occurred in latitude 78° 34′, Capt. Ross in Baffin's Bay found it so low as 1.020; and Capt. Parry, near Melville Island, found it still lower, being little more than 1.01.

The water of the main ocean is well known to be as transparent and as colourless as that of the most pure springs, and it is only when seen in deep seas that any certain and unchangeable colour appears. The prevailing colour is ultra-marine blue, differing but a shade from the colour of the atmosphere when free from obscurity. But in many parts of the polar seas the colour changes to olive green, and the water becomes extremely turbid. Henry Hudson, the Arctic navigator, was perhaps the first who noticed this circumstance, in the year 1607. Captain Parry and Captain Scoresby observed the same. Hudson attributes the turbid green colour to the influence of the ice; and Capt. Parry, on first seeing brown-coloured water in Davis' Strait, considered it as produced by an admixture with rain water. The true cause, however, of this turbidity and change of colour, was discovered by Mr. Scoresby to arise from an innumerable quantity of minute medusæ and animalcules contained in the water. He found that a cubic inch of the olive-green water contained about 64 medusæ. In this proportion, a cubic mile would contain about 23,888,000,000,000,000! The sea where this water occurred was above a mile deep; but supposing these animals to extend only to the depth of 250 fathoms, the above number of one species of animal would still occur in a space of two miles square,—a number, which Mr. Scoresby calculates would have required 80,000 persons to have started at the creation of the world to have completed the enumeration at the present time.[||]

"What a stupendous idea this fact gives of the immensity of creation, and of the bounty of divine Providence, in furnishing such a profusion of life in a region so remote from the habitations of men! But if the number of animals in a space of two miles square be so great, what must be the amount requisite for the discoloration of the sea, through an extent of perhaps twenty or thirty thousand square miles?"[¶]

These animals, Mr. Scoresby observes, are not without their evident economy, as on their existence possibly depends the being and preservation of the whole race of *mysticete*, and some other species of cetaceous animals. For the minute medusæ apparently afford nourishment to the *sæpiæ*, *actiniæ*, *cancri*, *helices*, and other genera of Mollusca and Aptera, so abundant in the Greenland sea, while these latter constitute the food of several of the whale tribe inhabiting the same region: thus producing a dependent chain of animal life, one particular link of which being destroyed the whole must necessarily perish.[††]

Besides these medusæ, the Arctic seas abound with other still smaller animals. In two or three instances, Mr. Scoresby has met with extensive patches and streaks of the sea of a yellowish green colour, having the appearance of an admixture with flowers of sulphur or of mustard. These occurred near the east coast of Greenland, in the parallels of 70° and 73° north. Suspecting the colouring matter to be of an animal nature, Mr. Scoresby examined some of the water by a powerful microscope, when his conjectures were confirmed by the discovery of animalcules in immense numbers. The larger proportion of these, consisting of a transparent substance of a lemon yellow colour, and globular form, appeared to possess very little power of motion; but a part, amounting perhaps to a fifth of the whole, were in continual action. Some of these being seen advancing by a slightly waving motion, and others spinning round with a considerable celerity, gave great interest and liveliness to the examination. But the progressive motion of the most active, however distinct and rapid it might appear under a high magnifying power, was in reality extremely slow, for it did not exceed an inch in three minutes. At this rate, they would require 151 days to travel a nautical mile. The condur, it is generally believed, could fly round the globe at the equator, assisted by a favourable gale, in about a week; these animalcules in still water, could not accomplish the same distance in less than 8935 years!

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[*] *Arctic Regions*, i. 110.

[†] Ibid. i. 111.

[‡] *Edin. Phil. Journal*, p. 162.

[§] Scoresby's *Arctic Regions*, i. 182.

[||] Ibid. i. 179.

[¶] Ibid. i. 180.

[††] Ibid. i. 180.

The vastness of their numbers, and their exceeding minuteness, are circumstances discovered in the examination of these animalcules of uncommon interest. In a drop of the sea water, examined by a power of 28.224 (magnified superficies,) there were fifty in number on an average, in each square of the micrometer glass of $\frac{1}{840}$th of an inch in diameter; and as the drop occupied a circle on a plate of glass containing 529 of these squares, there must have been in this single drop of water, taken from the surface of the sea, in a place by no means the most discoloured, about 26,450 animalcules. Hence, reckoning sixty drops to a dram, there would be a number in a gallon of water, exceeding by one-half the amount of the population of the whole globe! How insignificant, in point of numbers, is man! What a conception does it give us of the minuteness of creation, when we think of more than 26,000 animals living, obtaining subsistence, and moving at their ease without annoyance to one another, in a single drop of water! The diameter of the largest of the animalcules was only the two thousandth of an inch, and many only a four thousandth. The army which Bonaparte led into Russia in 1812, estimated at 500,000 men, would have extended in a double row, or two men abreast, with two feet three inches space for each pair of men, a distance of 106½ English miles; the same number of these animalcules, arranged in a similar way in two rows, but touching one another, would only reach five feet two inches and a half! A whale requires a sea, an ocean to sport in; about a hundred and fifty millions of these animalcules would have abundant room in a tumbler of water![*]

In regard of temperature, the polar seas present some remarkable facts. In situations where the sea is perpetually covered with ice, and where the mean temperature of the atmosphere is below 20°, the temperature of the surface of the sea, it might be reasonably expected, would be about the freezing point in all seasons. This is no doubt generally the case; but there are extraordinary exceptions, for in some situations of this description, in the keenest frosts, and in the midst of ice, the temperature of the sea, as high as the 76th or 78th parallel, is sometimes 8 or 10 degrees *above* the freezing point.

A circumstance equally extraordinary in the temperature beneath the surface, was discovered by Mr. Scoresby in the Spitzbergen sea. He found, by a series of experiments commenced in the year 1810, that in latitude 76° to 80°, longitude 10° east to 0°.10′ west, in situations where the surface temperature was about 29° on descending fifty fathoms, it was often 3°, and in some instances 5° higher; and in latitude 80°, at the depth of 120 fathoms, the temperature was 36°.3, while at the surface it was only 29°.7. In one experiment, at the depth of 4380 feet, the temperature was 37°, and in another, at the depth of 4566 feet, it was 38°, the temperature at the surface being 29° and 32°.[†]

In other parts of the globe the temperature is almost invariably found to diminish on descending. Within the tropics, in the Atlantic, the diminution of heat, on an average of 39 observations by Dr. Horner, was 19°.1 of Fah. for 68 fathoms; but in several instances the difference was upwards of 25°.[‡] In the temperate zones, the diminution of heat is less considerable, but still very apparent; and even in Baffin's Bay and Barrow's Strait, so high as the 74th or 75th degree of latitude, a fall of temperature was found to take place beneath the surface.

The depth of these seas corresponds, in a considerable degree, both in irregularity and quantity with the height of the Arctic lands. Hence the commonly received opinion, that where a coast is mountainous or precipitous the sea which washes it is deep; and that where the land is low the sea is shallow, obtains a general confirmation. There are many exceptions to the law, indeed, but not a sufficient number to render the general fact at all questionable. Thus between Spitzbergen and Greenland, where the coast on both sides is high and mountainous, we find the sea at a distance from land generally unfathomable. Mr. Scoresby sounded in this sea several times with 4000, 5000, 6000, and in one instance with 7200 feet of line, without finding bottom; and in the comparatively narrow sea of Baffin's Bay, Captain Ross found a depth of 1000, 1005, 1050, and 1070 fathoms, at the respective distances only of 6, 21, 24, and 9 miles from the land. In the "Polar Sea," on the other hand, near the North Georgian islands, where the land is generally low, Captain Parry found the sea proportionally shallow. In the sea on the north of Russia, where the prevailing character of the land is low, the soundings are also shallow.

The effect of the pressure of the sea at the great depths to which some have sounded, is remarkable. Mr. Scoresby made a number of experiments on the comparative impregnation of blocks of various kinds of wood, of different forms and magnitudes, by sinking them to various depths from 2000 to 7000 feet. At the depth of about 2000 feet, each kind of wood became specifically heavier than water; and at the depth of 6348 feet, each kind was found to have gained from 106 to 161 grains per cubic inch in weight. The largest pieces of wood gained the most in weight. A cube of ash of four cubic inches solid content, gained 145 grains per cubic inch; a cube of the same wood of half the bulk, gained 137 grains; and cubes of an inch, at different depths above 2000 feet, gained from 127 to 135 grains in weight. But these effects are not surprising, when we consider the enormous pressure to which the pieces of wood were subjected. The weight of a column of sea-water 6348 feet high, without allowing for the compression, being 2823 lb. or 25 cwt 23lb. on one square inch of surface: hence the largest cube made use of in these experiments, though only $1\frac{5}{16}$ inch in diameter, must have been compressed with a force exceeding 19 tons![*] The whale is frequently known to descend in these seas to the depth of 800 fathoms, or upwards, at which depth, (the animal exposing about 1540 square feet of surface, where the weight of water is about $137\frac{1}{4}$ tons per square foot,) it must be exposed to a pressure of more than two hundred thousand tons,—a pressure which, we are informed, exceeds the weight of sixty of the largest ships of the British navy, when manned, provisioned, and fitted for a six months cruize![†]

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[*] *Edin. Phil. Journ.* iv. p. 111.

[†] *Account of Arctic Regions*, i. 187.

[‡] Dr. Horner's remarks on the specific gravity of sea water, *Edin. Phil. Journ.* vi. 161.

By the influence of currents, the waters of the Arctic seas are mixed with those of the Atlantic, and probably circulated through the greater part of the ocean. The prevailing current in the Greenland sea is towards the south-west, with a velocity of five to twenty miles per day.[‡] In Baffin's Bay it generally sets to the southward. Along the northern face of the European and Asiatic continent, it is chiefly to the westward. And in the Icy Sea, about Behring's Strait, it is towards the north-east, with a velocity, as observed by Lieutenant Kotzebue, of near two miles and a half an hour.[§]

But many of these currents are superficial. While the upper waters of the Greenland sea are setting constantly to the south-westward, an under stratum is probably setting the contrary way. On what other supposition are we to account for the warmth of the lower water near Spitsbergen, where the mean temperature is so far below the freezing point? It is, therefore, highly probable, that a branch of the Gulf Stream, which is known to set towards the Orkney Islands, may extend its course to the coast of Norway, and be from thence deflected towards the north, until it is at length overrun by a stratum of water, that, though colder, may be specifically lighter.

Such a transfer of the cold waters of the Arctic zone and the warm waters of the south, is one of those beautiful instances of beneficence, which the economy of the globe in so many particulars presents. By this transfer, the polar seas are preserved above the freezing temperature, which prevents the whole mass of water from becoming a solid bed of ice; while on the other hand the excessive heat which the sea within the tropics would otherwise attain is greatly reduced and moderated. We see, therefore, why the Greenland sea, in the meridian where this warm submarine current ascends, is navigable to a greater extent towards the pole than any other part of the globe; we also see why the superficial Gulf Stream brings light floating bodies across the Atlantic to the British shores, while at the same time the deep current out of the Greenland sea at Baffin's Bay, carries icebergs and other heavy bodies to the southward along the American coast; and we also have an explanation of the coldness which prevails at great depths in tropical seas, and the warmth at like depths in the Greenland sea. We likewise see why the food of the whale, consisting of animals having little locomotive powers is not dispersed into southern seas, these little creatures probably possessing sufficient instinct to sink to a considerable depth in the sea when they are carried beyond their natural place of habitation, by which they must be returned to their former station by the reverse action of the lower current.

Sect. IV.—*Ice.*

Beyond the 72d degree of south latitude and the 82d degree of north latitude, we have no satisfactory account of any navigator having ever penetrated. The obstruction hitherto met with has not been land but ice. The extent of impenetrable ice is not similar in both hemispheres, nor does the margin of the polar ice describe any parallel of latitude, or even any regular curve. The highest attainable latitude is on the west coast of Spitzbergen, where the whale fishers annually reach the 80th or 81st degree. The next highest latitude open to navigators is in Baffin's Bay, where, almost every summer, the 76th or 77th parallel is accessible. On the coast of Nova Zembla, and near Cape Ceverovostichnoi, a similar height, it appears may be attained. In all other situations yet known, little advance can be made beyond the latitude of 72° or 73°. From careful inspection of the line of impermeable ice, it would appear a space containing near a million of square miles about the northern pole, and a million and a half or more around the southern pole, is totally unknown, being rendered inaccessible to navigators by an hitherto insurmounted barrier of ice. Some description of this ice will now be given.

Several different kinds of ice occur, distinguished by their thickness, elevation, extent, &c. Some of these it may be useful to define.

An *iceberg*, or ice mountain, is a large insulated peak of floating ice; or a *glacier*, occupying a ravine or valley in an arctic country.

A *field* is a sheet of ice so extensive, that its limits cannot be discerned from a ship's mast-head.

A *floe* is similar to a field, but smaller, inasmuch as its extent can be seen. This term, however, is seldom applied to pieces of ice of less diameter than half a mile or a mile.

Drift ice consists of pieces less than floes, of various shapes and magnitudes.

Bay ice is that which is newly formed on the sea.

A *hummock* is a protuberance raised upon any plane of ice above the common level.

A *calf* is a submarine hummock.

A *pack* is a compact body of drift ice, of such a magnitude that its extent is not discernible.

A *patch* is a collection of drift ice or bay ice, of a circular or polygonal form. In point of magnitude, a pack corresponds with a field, and a patch with a floe.

A *stream* is an oblong collection of drift ice, the pieces of which are continuous.

On the freezing of sea-water the greatest part of the salt it contains is deposited, and the frozen mass, however spongy, contains little or no salt but what is natural to the water filling its pores. The ice at first formed on the sea is generally very porous; but, as it increases in thickness, it attains considerable solidity, and on being washed in fresh water, and allowed to drain, is found to be quite free from salt.

Bay ice, fields, and floes, are formed upon the sea. The production of bay ice, which may take place in a few hours, is often observed; and its increase, until it attained the thickness of seven feet,[‖] has been witnessed. But the formation of fields, which requires perhaps many years, and takes place in situations not secessible to navigators, has not been seen completed. Some fields, from their appearance, are evidently derived from the cementation, by the agency of frost, of the pieces of a closely aggregated pack; but the most considerable masses appear to be generated either in extensive bays, or in openings of the far northern ice. These are first derived from the waters of the ocean, but, it is highly probable, that they are indebted for a considerable portion of their superstructure, to the annual addition of the whole or part of their burden of snow. Icebergs, on the other hand, appear to be in general derived from the glaciers generated on the land between the mountains on the sea-coast, and are consequently the product of snow or rain water. But some icebergs may possibly be formed in narrow coves, and deep sheltered bays, in any of the polar countries, where the set of the current, or prevailing winds, has not a tendency to dislodge them. And it is not improbable, that a continent of ice-mountains may exist in regions near the poles yet unexplored, the nucleus of which may be as ancient as the earth itself, and its increase derived from the sea and atmosphere combined.

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[*] *Account of the Arctic Regions*, vol. i. p. 203.

[†] *Arctic Regions*, ii. 250.

[‡] Ibid. i. 4.

[§] Barrow's *Voyages into the Arctic Regions*, p. 835.

[‖] Parry's Voyage.

The sea is liable to freeze, in sufficiently low temperatures, not only near land and in still water, but on the face of the northern ice, where it is exposed to the swells of the Atlantic. Its extension in such situations is liable to be checked by strong winds, bringing a heavy sea in amongst it; but even under such circumstances it has been observed to increase to such a thickness, as to be capable of stopping the progress of a ship with a brisk wind. Ice thus formed is reduced by the motion into small masses, which, being hustled together, become rounded, and have their edges turned up in resemblance of cakes. These masses have in consequence obtained the name of *pancake ice.* At the first these cakes are extremely small; but, as they acquire thickness, a number of them combine together, and form larger cakes; these, again, form to still larger masses, until they attain the breadth of several feet, or even yards. In calm sheltered situations, on the other hand, the product of the bay ice is in extensive unbroken sheets of a smooth and regular surface.

The ice of fields and of bergs is the most transparent. It occasionally resembles the purest crystal; and has been constructed into lenses capable of burning wood, firing gunpowder, and melting the more easily fusible metals.[*]

Though new ice and that of fields or bergs differ very considerably in appearance; the former being white, partly opaque, and the latter blackish, or, when in large masses, greenish, and transparent; yet the density of all kinds is very nearly equal.

The highest specific gravity observed by Mr. Scoresby, in a number of careful experiments, was 0.925, and the lowest 0.915; snow-water, temperature 32° being 1.000. But, compared with sea-water from the coast of Spitzbergen, temperature 35°; the specific gravity of ice is 0.900 and 0.894. As such, when ice is afloat in the sea, the proportion above to that below the surface, must be 1 to 8.2.[†] For every solid foot of ice, therefore, which is seen above water, in a mass floating in the sea, there must be at least eight feet below. A cubic inch of compact ice weighs 231.5 grains, and a cubic inch of sea-water at a freezing temperature, (specific gravity 1.0264, being the average of the Greenland sea,) weighs 259.58 grains; the weight of ice being to the weight of sea-water as 8 to 8.97 or 8 to 9 nearly.

The ice usually first met with by navigators is drift ice, or bergs; fields and floes are generally found in the interior ice, sheltered from the action of any swell.

Drift-ice occurs of almost every variety of size, thickness, and possible shape. At a little distance from the main ice, there is usually a quantity of scattered fragments, the ruins of larger masses, in a state of dissolution by the washing of the sea. Though of a description not to be compared with the beautiful extent and appearance of fields, or the grandeur of icebergs, yet the drift-ice is an object of much interest, and particularly on account of the infinite variety of curious and amusing shapes which it assumes. The most remarkable of these are formed in pieces where, on small separate bases, are reared prodigious blocks of ice, the original production of enormous pressure; but from the detrition of sea-water, in high winds and heavy swells, these perhaps shapeless and uninteresting masses become such exact resemblances of animals, or works of art, that they force themselves on the attention of the most vulgar and incurious. Resemblances of bears, sometimes elevated on pedestals, antique tables, surrounded with fringes of large stalactites of crystalline ice, collossal busts, resembling the monuments of Easter Island, vases, heads of different animals, and various pieces of almost perfect statuary, are not unfrequently seen; and tables, or roofs of vast magnitude, supported by Ionic columns and Gothic arches, the former consisting of capitals with ovalo, astragal, and other mouldings, and portions of the shafts founded on bases rendered invisible by submersion in the sea,—with other architectural forms of astonishing precision, have been observed by adventurers to the polar seas. Some of these figures are occasionally reared to the height of forty or fifty feet; and some of them have been calculated to weigh 200 or 300 tons. The architectural specimens seem the most extraordinary, as, in an infinite variety of shapes, the forms of animals and simple works of art must evidently occur occasionally; but the occurrence of Ionic columns, with regular mouldings, might be questioned, were we not able to account for their formation. A mass of ice of this description, which was recently seen in the Greenland sea, consisted of an immense table of ice, supported on a submarine base, by round columns, with excellent capitals and regular mouldings. Its formation is thus described by the person who saw it, and made a drawing of it at the time, for which he had ample opportunity, as the ship lay nearly becalmed near it for a considerable interval. It was a vast block of ice, perhaps 140 feet long, (the part above water,) and 15 broad. The base, which was invisible, was probably much more extensive. The table, or roof, consisted of rough fractured ice, covered with snow; the columns were of solid grey ice, and the arches between, of six or eight feet elevation above the water, and perhaps ten feet span. The columns were three in number. The original form of this mass, it is presumed, was that of a high irregular, but flattish hummock, raised upon a large and ponderous base. It had been exposed to a considerable sea, by which the roof had been greatly undermined on all sides, and at length perforated in two places, a circumstance which often occurs. As detached pieces of ice frequently turn round, as on a centre, by the action of the wind, waves, and other pieces in passing them, the irregular blocks supporting the roof of this piece of architecture, appeared to have been rounded by uniform attrition, whilst revolving so as to form these blocks into three columns. After this was accomplished it had got into smoother sea, but had yet been subjected to the action of a slightly ruffled surface, so as to hollow out the columns near the level of the sea; but some part of the roof being too much undermined had been broken off, by which the centre of gravity was changed so as to raise the columns and roof about six or eight inches. The slight waves now operating in a different place would reduce the columns below more than they were above, and consequently leave a moulding; a second loss of weight from the roof, which is continually happening in such kinds of ice, would elevate the roof a few inches more, and give rise to a second moulding. In this way, or somewhat in this way, there is no doubt but the piece of ice in question had been sculptured into the remarkable form that it bore.

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[*] Scoresby's *Arctic Regions*, vol. i. p. 232.

[†] As this result differs very materially from the experiments made in the recent voyages of discovery, it may be necessary to state, that Mr. Scoresby's method of obtaining the specific gravity of ice was by weighing the ice in sea-water at a freezing temperature, when sunk by a piece of metal, and then weighing it in air. The difference between the weight of the ice in water, with the load attached, and the weight in water of the load singly, showed the difference between the weight of the ice and an equal bulk of water; consequently, this difference, added to the weight of the ice in air, afforded the weight of an equal bulk of water; and the comparison of the two latter weights gave, in the usual way, the specific gravity of the ice. (See Account *Arctic Regions*, vol. i. p. 82.) The method employed in the discovery vessels, on the other hand, was by cutting a piece of ice in the form of a cube, and measuring the proportion above water when afloat. The discrepancy of the results show the inaccuracy of the process.

The construction of the table, a form that likewise frequently occurs, admits of an easy explanation. In this kind of figure, the stalk is often elegantly formed, and perfectly circular. The detrition of the sea, to which it is exposed, washes away the ice above the level of the water, and undermines the top. The occasional revolution of the mass, meanwhile, exposes every part progressively to the action of the waves, and thus produces a stem of a cylindrical form. When these tables become too heavy for the diminishing stem, the top breaks off, and leaves the ruin of the former structure an uninteresting and perhaps shapeless mass.

Drift ice is, in general, merely the ruins of larger masses; it is, therefore, necessary that we should give some description of fields and floes, the source from whence drift ice is chiefly derived. Occasional masses, indeed, are the fragments of icebergs, but by far the greater proportion is the product of field ice.

Ice-fields are common in the Greenland Sea. They occur there in immense numbers, and of vast magnitude. On inspection from a ship's mast-head, they appear to be interminable sheets of ice. They are often met with of the diameter of 20 or 30 miles; and when in a state of such close combination that no interstice can be seen, they sometimes extend to a length of fifty or even a hundred miles. Their edges, from frequent contact with one another, are often rugged, bluff, and hummocky. The margin is a zig-zag or waving line, full of indentations and projecting points. The surface of some fields is, here and there, regular and smooth, for an extent of thousands of acres; but most commonly it is diversified with numerous hummocks, either insulated or forming ridges and chains. The hummocks often reach the height of 30, 40, or even 50 feet. The average thickness of heavy fields may be stated at about 20 feet, though some are considerably thicker, and formed of the most solid ice. The general appearance of a heavy field of ice is bold, striking, and picturesque, particularly early in summer or spring, before the melting of the snows; but after the commencement of the rains and fogs of July, the sharp elevated hummocks become rounded and reduced, the snow wastes from the surface, and replaces the elegant whiteness with patches of naked ice and pools of water, and in many fields exhibits a disagreeable dirty surface, arising from a deposition of mud or earth, which had been concealed by the covering of snow. Thus the fields met with near the arctic circle appear about the end of summer to be rapidly wasting; but those of high latitudes, not being subjected to such a high temperature, are probably little reduced. Indeed such of the water as remains on these fields, together with all the snow that escapes dissolution, adds, by its conglaciation on the return of frost, to the thickness of the field. The picturesque quality of ice-fields arises from the numerous and diversified form of the hummocks—from the brilliant covering of snow, delicately shaded with blue in every cavern and recess—together with the prodigious extent of their surfaces, and the contrast they form with the darkness of the adjoining waters.

Ice-fields, notwithstanding their vast extent of surface, and deep immersion in the sea, are liable to a variety of motions dependant on currents, winds, and the contact of other ice. Currents are sometimes so extremely superficial, that bodies floating at different depths will be differently affected by their influence; thin ice will be carried by them with considerable speed, while thick or heavy ice is not sensibly moved by them. Most generally, however, the action of currents extends beyond the depth at which field-ice floats, and consequently operates on all kinds of ice of this and inferior thickness in a uniform manner. The influence of the wind over ice, however, is extremely unequal. The heaviest fields obey its impulse; and all ice acquires a motion, which increases as the thickness of the ice diminishes. Besides the motion in the direction of the wind, large sheets of ice are subject to a revolving motion, arising from the pressure of thinner ice, or ice having a greater velocity on the sides. And every kind of motion is modified by the dimensions and form of the mass of ice, the largest pieces drifting the slowest, and pieces of a circular form, or having equal diameters, the most directly to leeward. A long slip of ice seldom moves in the way of the wind, unless its axis happen to lie parallel to, or directly across the course of the wind. But, like a ship, being inclined to move in the line of its longer axis, its true course is always found between that line and the direction of the wind.

These various motions of the ice prevent it from drifting quietly in a body. They give rise, therefore, to partial separations and openings, and frequently bring the largest masses into contact. When fields that have different motions thus meet, they perhaps come in contact with a velocity of more than a hundred feet per minute, and produce a most tremendous shock. The effect of impulsion, indeed, from a body calculated not unfrequently to weigh more than ten thousand millions of tons, is scarcely within the power of imagination to conceive. The weaker field is crushed with a frightful noise; sometimes the destruction is mutual;

pieces of huge dimensions, and of the weight of many hundreds, sometimes thousands of tons, are piled upon the top, while similar masses are forced underneath. All intervening substances are, of course, either crushed to atoms, or buried in the ruins of the opposing fields. When the ships of the whale-fishers, who, for weeks and months together, during storms and the densest fogs, brave continually these dangers, get unfortunately involved between these opposing fields, their destruction is inevitable. Sometimes they are crushed to pieces,—occasionally they are divided in two, the deck and masts from the hold—perhaps they are cast, like one of the hummocks, upon the surface of the field—or sunk and forced beneath, and carried immediately out of sight. By such irresistible pressure, ships to the amount of 15 or 20 have been crushed in one season. As it will tend to illustrate the subject, we shall give a description of one of these calamities which overtook the whale-fishers who were pressing into Baffin's Bay in the year 1819.

These ships, endeavouring to penetrate betwixt the land ice and contiguous floes to the westward, were enveloped by the closing of the ice. For their security, they were all lodged in the land ice in docks, or lanes, sawed out of the ice. The Samuels, of Hull, among several others, was thus situated, in a dock 340 yards from the edge, which had been cut with immense labour out of ice 5 to 9 feet in thickness. The Ocean, another Hull whaler, was near the Samuels. The wind had been a moderate breeze from the W. S. W. in the morning of the 16th of July, the weather hazy. The exterior edge of the Samuels dock was yet unbroken; and, though heavy crushes had occurred to the southward, no alarming pressure had been experienced by this ship. Towards noon the wind freshened, and soon blew a very hard gale. About half past eleven in the forenoon, the captain, (with the chief mate and second mate of the Samuels) went down to breakfast, the ice being at rest, and no appearance of danger any more than there was from the beginning. As the second mate went upon deck, the officer on watch called down the companion, "I am afraid there is going to be a very heavy press." On which the captain and mate hastened on deck, and found that the western floes had joined the land ice, and were rapidly making an impression on them. The stern rope was let go, and an attempt made to force the ship out into a small basin of water to the northward. But before she was half way out, the floes were in contact with the exterior of the dock. In about ten minutes from leaving the cabin, the floes had over-lapped the land ice, and come in contact with the vessel. The pressure broke away the leeside of the dock, forming an angle in the ice just in the midships of the vessel, which at once penetrated the side of the ship with a hole of thirty feet; the ship then forging a-head, being under all sails, fell into the basin of water to leeward, and then heeled down on one side. On this the mate ran into the cabin with the hope of saving the papers, along with the master of the Ocean, who was on board. They seized on some trifling articles, and Captain Cousins escaped with the assistance of a rope, handed by some men on deck out of the companion. But on the mate's attempting to get up, the ship being on her broad-side, the water pouring down forced him back; he then ran to the cabin window, and forcing it out with his feet, crawled up on the quarter or side of the ship, where he found his master just climbing the bulwark to the same position. Here they remained some time; the rest of the crew in general having left the ship in the boats. The ship was a quarter of an hour from being stove to the time of her falling over.

The ice had now stopped running; but in about three quarters of an hour afterwards a fresh crush ensued. The first run was at the rate of three or four knots; the second was nearly as fast. In a few minutes it again reached the ship, filled up the hole of water, and forced her *out of sight* under the land ice. In the course of ten or fifteen minutes after this, the Ocean was caught by the crush, and pressed on the broadside and on the bow, so that she burst open; the masts fell, and in twenty minutes after the first of her receiving the crush, she was overrun by the ice, and, for the time, totally disappeared. Both of these ships crews all escaped and took refuge in some ships that were preserved. This was on Friday; some of the people were in tents until the Sunday following before they got on board any ship.

On the 11th of the same month the Equestris and Sisters, lying in the same dock in the land ice, a little to the southward of the Samuels, were wrecked. About four o'clock in the afternoon the press took place, and never stopped until the Equestris passed fairly over the Sisters, and buried her in the waters. The crush then ceasing, the Equestris righted; but, in a very few minutes, the run recommenced, and the seaward floe penetrated her broadside, carried away all her masts, and actually forced the cables and other stores out of the gunroom, through the side of the ship upon the ice. She was, in fact, completely crushed to pieces.

Out of all the ships that were wrecked, only one man lost his life; and he did so in consequence of exposure, in a fit of drunkenness, after the ship was lost.

The fatal error with these ships seems to have been their adhering to the land ice, and relying on their docks cut in it; as all the ships that kept to the westward, among the loose ice and distant floes, were preserved. One old vessel, capable of sustaining no considerable pressure, had never a dock cut out at all; she was driven about almost entirely at the caprice of the winds, and at the mercy of the ice, and sustained no damage. She indeed appeared to be in such danger that the crew left her, and took their clothes to the ice; but, in doing so, some of them lost their property—the ship drifting so fast from them, as to oblige them to desert their clothes to regain her.

Hard and impenetrable as the ice of fields is, it is incapable of sustaining, without fracture, the operation of a *grown* swell. A considerable lipper, or even short sea, may act against a field without producing any effect upon it; but a grown swell, though so low as scarcely to be perceptible in open water, frequently breaks up the largest fields, and converts them into floes and drift ice, in the space of a few hours; while fields composed of bay-ice or light ice, which is more flexible, endure the same swell without any destructive effect.

The invariable tendency of the ice of the Greenland sea to drift to the south-westward, is the occasion of great numbers of fields being annually destroyed. They have frequently been observed to advance a hundred miles in this direction, within the space of a month; and sometimes under strong northerly gales they have been known to perform the same distance in a week. On emerging from amidst the smaller ice, which before sheltered them, they are soon broken up by the swell, converted into drift ice and eventually dissolved. The places of such are uniformly filled up by other fields from the north, which affords an inexhaustible supply.

Besides the ices already described, the floating iceberg remains to be considered. The fixed iceberg, or glacier, is the parent of these considerable islets. Few of them occur in the Spitzbergen sea, and these only of inferior magnitude: but on the east coast of Greenland, in Baffin's Bay, Davis's Strait, with the adjoining seas, and also in many parts of the Antarctic regions, they are met with in vast numbers, and of a prodigious size.

A floating object of such magnitude as the iceberg, naturally attracts the attention of navigators. They are described by Ellis, Frobisher, Middleton, Ross, Parry, Scoresby, and others. Captain Middleton describes the occasional size of bergs as being three or four miles in circumference, and 100 or 120 fathoms thick; and Ellis and Frobisher mention icebergs of still greater thickness. Captain Ross saw many in Baffin's Bay and Davis's Strait of above 1000 feet in diameter, and he mentions several being seen aground in 250 fathoms water. He describes one in particular that was aground in 61 fathoms, the diameter of which was 4169 yards by 3689 yards, its height 51 feet, and calculated weight 1.292.397.673 tons. Captain Parry describes an iceberg that was 140 feet high, and aground in 120 fathoms: he saw some others that were from 150 to 200 feet above the level of the sea; and one that was aground near the river Clyde, above two miles long, which had been seen by Captain Ross two years before.

In some parts of Davis's Strait and Baffin's Bay, icebergs occur in great numbers. Captain Parry saw 62 large ones at a time, in latitude 70°; Captain Ross at least 700, great and small, at once; and Mr. Scoresby, on the eastern coast of Greenland, counted above 500 at once, of which scarcely any was less than the hull of a ship; and about a hundred of them appeared to be as high as a ship's mast-head, or 100 feet. Some were twice this height, and several hundreds of yards in extent. In the Antarctic regions, they have been seen in equal numbers, and of similar magnitude. Captain Cook met with many that were one or two miles in extent, and upwards of 100 feet above the surface of the sea. On one occasion 186 were seen at the same time from the mast-head, of which none was less than the hull of a ship.

Icebergs exhibit an infinite variety of forms. Some have regular flat surfaces; but most generally they have one or more acute peaks, and occasionally exhibit the most extraordinary and fantastic shapes. They have often been seen completely perforated, or containing vast caverns, or having such deep clefts or chasms in the most elevated parts, as to exhibit the appearance of several distinct spires.

The colour of icebergs varies according to their solidity, distance, and state of the atmosphere. A very general resemblance is a cliff of chalk, or of white or grey marble. The sun's rays reflected from the surface, often give it a glistening appearance; while a variety of tints are sometimes observed in their colour, arising from the different inflections and reflections of light. The most general colour of the solid ice, however, is greenish-grey, approaching to emerald green.

The structure of the iceberg is generally stratified: the strata are marked by a difference of tint, and by occasional layers of earthy substance. In icebergs, wherein the strata are vertical, there is sometimes a kind of basaltic character, particularly when the berg is in a state of dissolution. They possess a degree of effulgence which renders them distinguishable in the darkest night, and is a providential property, by which the danger to the navigator is greatly diminished. Hence icebergs occurring singly, have seldom been productive of shipwreck: but when they occur in extensive chains, as is sometimes the case in the mouth of Davis' Strait, they become extremely dangerous, so that several fatal accidents have happened, by vessels getting involved among them in the night, during storms.

Ice, of the most solid texture, becomes extremely brittle after being for some time exposed to a temperature a few degrees above the freezing. It resolves itself into prismatic columns; and when these happen to be vertical in their position, they are liable to be separated by the slightest blow. Icebergs, in this state, on being struck by an axe, for the purpose of placing a mooring anchor, have been known to rend asunder, and precipitate the thoughtless seamen into the yawning chasm: occasionally the berg is divided by the stroke, and the two masses hurled apart with a prodigious crash, overwhelming boats and men amid its ponderous ruins.

In this state, indeed, the fragility of ice is such, that bergs often break in detached portions spontaneously; so that not only a blow with an edge tool, but the slightest vibration in the air, may hasten its separation. Hence the Greenlanders, who, from fatal accidents happening among them from this cause, are well aware of the danger, allow no sound to escape them when passing an overhanging iceberg; but if they have occasion to speak, it is always done in a suppressed whisper. Hans Egede Saabye, who was missionary in Greenland in the years 1770 to 1778, mentions in his journal some remarkable instances of the separation of icebergs by the vibration of the air. He states, that in the neighbourhood where he resided, and during his stay in Greenland, seven persons perished in a boat by the fall of an iceberg, which appeared to have been accelerated by a noise made by a lad, who wantonly struck the skin stretched over the boat with a piece of wood. The act was observed by a Greenlander, who was near the boat at the moment in his kaijak: he stated that the sound arising from the blow on the tense skin, was reverberated from the summit of the berg, and instantly the fall of ice took place.*

The noise of a falling iceberg resembles peals of thunder, which is echoed from berg to berg, and from mountain to mountain, to an astonishing extent. The effect on the sea is extraordinary. The waves produced by it overwhelm every neighbouring object, and frequently break up extensive floes.

The north polar ice, chiefly consists of fields, floes, and drift ice. The outline pursued by it is determined by the set of the currents,—position of neighbouring coasts,—and the nature of the climate. These circumstances give the southern frontier a very irregular form. On some meridians the edge of the arctic ice ascends within twelve degrees of the pole; in others it descends to the southward of the sixtieth parallel of latitude. Its general tendency, however, is tolerably determinate; but the varying influence of the winds produces partial irregularities.

With each recurring spring, the north polar ice presents the following general outline. Filling the bays of Hudson and Baffin, as well as the Strait of Hudson and part of the Strait of Davis, it exhibits an irregular waving, but generally continuous border, from Newfoundland or Labrador, to Nova Zembla.

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* Saabye's *Journal in Greenland*, p. 103.

From Newfoundland it extends in a northerly direction, along the Labrador shore, generally preventing all access to the land during winter, as high as Hudson's Strait; then turning to the north-east, east, and south, forms a bay near the coast of Greenland. After doubling Cape Farewell, it advances in a north-eastern direction along the east coast, sometimes enveloping Iceland as it proceeds, until it reaches the island of Jan Mayen. Passing this island, the edge of the ice then trends a little more to the eastward, but afterwards turns to the northward, and forms a bight off the west coast of Spitzbergen. This bight sometimes extends to the latitude of 80°, or even higher; at others it is crossed by a barrier in 75° or 76°. From the southern part of Spitzbergen, the ice runs south-easterly to Cherie Island, which having passed it proceeds more to the eastward, until it forms a junction with the coast of Nova Zembla or that of Siberia.

During the whole of the winter and spring months, the Polar ice seems closely to embrace the whole of the northern shores of Russia, to the eastward of Nova Zembla; and filling in a great measure the sea to the northward of Behring's Strait, it continues in contact with the polar face of the American continent, until it probably joins the ices of Baffin's Bay.*

This general termination to the polar ice is not, however, observed by the iceberg. Its vast bulk and thickness enable it to resist, for a longer period, the destructive influence of both temperate climate and turbulent seas. It often, therefore, gets drifted many degrees to the southward of the continuous ice; and it has been conveyed before dissolution, by the under current running out of Davis's Strait to the southward, as far as latitude 40°, or even farther, a distance of at least 2000 miles from the place of its origin.

The line pursued by the margin of the Arctic ice, it has been intimated, is in a general way tolerably determinate. But occasional variations take place. Thus in the Greenland sea, after an extraordinary prevalence of northerly winds, a more than usual quantity of ice is drifted into milder climates, so that the Spitzbergen sea is uncommonly open; and, on the contrary, after an extraordinary continuance of southerly winds throughout the winter, retarding the common efflux of ice, the channel between Spitsbergen and Greenland is sometimes completely filled. Such deviations are, however, soon compensated, and the ordinary outline again restored.

One known exception has occurred, which is the most remarkable alteration in the configuration of the polar ice on record. In the eleventh, fourteenth, and intermediate centuries, it would appear from the credible testimony of Icelandic historians, there was a constant trade carried on, in the summer and autumn at least, between the colonists of the southern, and perhaps the eastern parts of Greenland, and the mother country Iceland. We read of no particular interruption to this intercourse, until the beginning of the fifteenth century, when the polar ice is supposed to have first descended so as completely to embargo the whole of the colonized districts of Greenland. Thus far appears very certain, that these coasts, where the colonies were supposed to be planted, are now generally enveloped in ice; and that the many attempts made by Denmark to recover these colonies, or even to effect a landing upon them, have altogether failed. Hence it is generally supposed, that they are now inaccessible, and that the imprisoned colonists have long ago perished from the want of their usual supplies.

That the polar ice has descended beyond its ancient boundaries, and that a great body of it usually lies off the eastern and southern coasts of Greenland, are facts that cannot reasonably be disputed; but its inaccessibility, notwithstanding the failures of the Danish navigators, is by no means proved. Nay, on the contrary, we have the greatest reason to believe, and that from the best existing authority, namely, that of persons who have been in the habit of visiting the polar seas for many years in succession, that the eastern coast of Greenland may be reached almost every year; and, indeed, that it has ofttimes of late been approached, as near as the whale fishers deemed desirable, in a latitude at least ten degrees higher than that of the ancient colonies. The want of success, therefore, in the Danish voyagers who were sent out in search of the lost colonies, is to be attributed to the want of energy of the attempts, or the inexperience of the commanders in the navigation of icy seas, rather than to the impenetrability of the frozen barrier.

The occasion of the change of climate about Iceland and Greenland, is ascribed to the descent of the polar ice; but the real cause of this phenomenon is a question which will be touched upon in our next section, when we come to speak of the climate of the arctic regions.

The quantity of ice annually destroyed in the Polar regions, or in the adjacent seas into which it is drifted, is equivalent to the annual produce in the higher latitudes. The winter's produce of ice between Greenland and Spitzbergen, in Davis's Strait, Baffin's Bay, Hudson's Bay, and adjoining seas, is perhaps wholly dissolved in the succeeding summer, besides a vast quantity brought by currents from regions near the pole. Hence, however close these seas and bays may be during the winter and spring, we find them, for a few months in each year, quite open and accessible to the adventurous whalers.

The actual produce of ice, within the Polar circle, in any one winter, has been seldom accurately marked. Captain Parry ascertained this fact, however, in Winter Harbour, Melville Island. From the middle of September 1819, up to 23d of March following, the produce of ice was a sheet of 7 or 7½ feet thick, being 6¾ feet of solid ice, and about 8 inches of snow. By the 6th of July, this ice was dissolved into holes, and the average thickness reduced to about two feet. The holes first appeared, it is observable, where the water was most shallow, and there the freezing of the water first took place. About the middle of this month, the whole of the winter's produce of ice, inshore, was found to be nearly wasted away. In this instance, the wasting of the ice was the mere effect of temperature; but in parts of the Polar seas less sheltered, the action of the waves, which is much more rapid than that of warmth, greatly accelerates the destruction of the young ice. In many cases, this destruction is most rapid, and an entrance into the northern bays and seas opened with astonishing celerity. Sometimes the whole of the obstruction to the passage of the whalers, up the western coast of Spitzbergen, consisting of a barrier of 20 or 30 leagues of ice, has been destroyed or dispersed by a heavy sea in a few hours; and, in general, however formidable the obstruction met with by the Spitzbergen whalers, in attaining the northern fishing stations, the whole is removed before their return; so that, by pursuing a proper course, they may lead out in a clear sea, where it costs immense exertion to penetrate.

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* Scoresby's *Arctic Regions*, vol. i. p. 265.

SECT. V.—*Climate.*

Our limit, as indicated by the title of this article, confines us to the regions beyond the latitude of 66½°; but as the *climate* of some countries lying to the southward of the Arctic circle, is of the polar kind, and may be useful for illustrating that of the Arctic regions in general, we shall not scruple, in this part of our subject, to step across the boundary.

In proportion as we recede from the equator towards the poles, the climate becomes more variable, and the temperature more fluctuating. While, in the polar regions, we have the severest natural colds that occur on the face of the globe, during the winter, we have, on certain parts of the Arctic lands, almost an equatorial temperature during a brief part of the summer. The extremes are probably 140° of temperature asunder, the range extending from about 80°, the highest summer heat, to—50° or—60°, the average greatest winter cold. This sultry temperature of summer, however, is confined to local situations on the land, and is owing to the perpetual influence of the sun during several successive months, acting vertically upon the sides of the hills, and producing its extraordinary effects in the adjoining valleys. For, at a distance from the shore, the temperature, in the finest weather, seldom rises above 45°.

In the autumn and spring seasons, the climate is more particularly variable and tempestuous. The temperature sometimes passes through its extreme monthly range, which probably exceeds 50 or 60 degrees, with a rapidity unknown in other zones. North, west, and east winds, in Spitzbergen and Greenland, bring with them the extreme frost of the surrounding icy regions, whilst a shift of wind to the southward elevates the temperature towards that of the neighbouring seas.

But, in winter and summer, the temperature of the atmosphere is very uniform, especially in situations far removed from the open sea. From the 17th of December to the 6th of March following, the temperature at Melville Island, where Captain Parry wintered, was uniformly below zero; and, in the Greenland Sea, in summer, especially during the foggy season, the temperature is still more strikingly regular. During fogs, the thermometer is generally near the freezing point, seldom varying above three or four degrees between midday and midnight; and sometimes it is so steady, that for two or three days together, there is not a variation of more than a degree or two.

While, on the one hand, the Arctic regions in summer have perpetual sunshine, extending from a week to six months together, in proportion as we remove from the Arctic circle towards the pole; so, on the other hand, in winter, they are doomed to continued night for nearly a similar period. But, while thus deprived of the genial rays of the sun, they enjoy an advantage from the moon which no other part of the globe, excepting the corresponding south polar regions, possesses. Thus, in the winter season, in Spitzbergen, and other places in similar latitudes, the moon, from her first to her last quarter, sweeps round and round the horizon without setting, for ten or eleven days together; thus bestowing her best and most constant influence on those regions most needing her light, and withdrawing it proportionably from those which have at the time the benefit of the sun's presence. This economy of the moon, which is so beautifully adjusted as to afford the greatest possible benefit to every part of the globe, in the most equitable succession, and to proportion that benefit to the deficiencies of the solar light, is, perhaps, among the finest displays of infinite wisdom and beneficence which the study of the planetary and solar system, though replete with such evidences of perfection, presents.

The most severe cold, says Crantz, that occurs in Greenland, sets in, as in temperate climates, "after the new-year, and is so piercing in February and March, that the stones split in twain, and the sea reeks like an oven." On the 15th of February, the greatest cold, that was experienced by Captain Parry at Melville Island, occurred. The thermometer on shore fell to—55°; and for 15½ hours it never rose above —54°. Even at this extreme temperature, no particular inconvenience was suffered when there was no wind; but, on walking against a very light breeze, a smarting sensation was experienced all over the face. Mercury froze in the open air, and was beaten out on the anvil. The effects of the cold were very curious. The Hecla had double stern windows; on opening the dead-lights, after four months, more than twelve large buckets full of ice, the produce of the frozen vapour, arising principally from the moisture exhaled in breathing by the gentlemen occupying the cabin, were removed. The temperature of Captain Parry's cabin fell as low as +7°, on the 17th of February, which stopped two of the chronometers. This was occasioned by uncovering the stern windows. The officers often wore their great coats in the cabin, and put them off when they walked abroad. The breath of a person walking was so suddenly condensed, that it looked like the smoke of a musket. On the 24th of February, when the temperature of the atmosphere was —44°, several of the sailors suffered severely from frost-bites, owing to a peculiar exposure in subduing a fire that occurred at their observatory on shore. Some of the sailors had their noses frozen; and one man lost part of several fingers. The contraction of the timbers of the ships, occasioned by the coldness and dryness of the air, produced a frequent and loud cracking noise, as the temperature fell; but it was observed that when this effect had taken place at a certain temperature, it did not recur, excepting at still lower temperatures. Captain Middleton, in describing the cold of Hudson's Bay, and several other polar navigators, mention similar effects of cold. In the journal of Captain Ellis, who wintered in Hudson's Bay in 1746-7, without the limit of the polar circle, we are informed that several of the sailors had their faces, ears, and toes frozen; that iron adhered to their fingers; that glasses used in drinking stuck to the mouth, and sometimes removed the skin from the lips and tongue; and, that a sailor, who had inadvertently used his finger for stopping a spirit bottle, in place of a cork, while removing it from the house to his tent, had his finger fast frozen in the bottle, in consequence of which, a part of it was obliged to be taken off, to prevent mortification. Captain Scoresby, in his Account of the Arctic Regions, gives several other examples of the effects of severe cold; and, in his *Journal of a Greenland Voyage in* 1822, he mentions a case which occurred in the whale fishery of that year, that was more destructive than any example that he has given of the effects of the winter temperature. The crew of the King George, it appears, struck a fish during a severe gale that occurred in the month of May, when the thermometer fell to zero, or below. Thick weather setting in, they lost sight of the ship, and were exposed on the ice, to the severities of this intense cold, for fifty hours. One man fell a victim to the cold while on the ice, and another died soon after he reached his ship. All of them suffered from the severity of the exposure more or less. Some lost their fingers; others their toes; some lost their hands, and others their feet. Thirty-five fingers and toes were amputated in one day. An example was given of the severity of the cold, by one of the King George's sailors, who stated, that a quantity of beef that was sent in a boat to the men upon the ice, when they first saw them, was taken hot out of the coppers, but, before they reached the ice, though at no great distance, it was frozen so hard that they had to cut it in pieces with hatchets. It is an observation of several arctic voyagers, that the sensible effect of cold depends in a great measure on the strength of the wind; for it appears very probable that the lowest temperature experienced by Captain Parry, —54°, is as tolerable to the feelings in perfectly calm weather, as a temperature 40 or 50 degrees higher, under exposure to a severe gale. In the former case, there is a warm atmosphere of partially stagnant air formed in the clothing and about the person of every individual; but, in the latter, the warm air derived from the animal heat is carried off as rapidly as given out.

Until the observations on the temperature of the atmosphere in the Greenland Sea, by Captain Scoresby, made between the years 1807 and 1818, the severity of the cold of the Arctic regions was extremely underrated by meteorologists. The celebrated astronomer Tobias Mayer, of Göttingen, who was the first person that attempted to deduce from observation a general expression for the mean temperature of all latitudes, calculated the mean temperature of the north pole to be 31°. But Captain Scoresby, by an analogical process, has shown that the cold at the pole must be as low as about 10°. By observations made in the months of April, May, June, and July, near the coast of Spitzbergen, he found the mean annual temperature of the parallel of 76° 45′ N. (derived from a satisfactory formula for calculating the mean temperature of the year, from observations made in a part of the year,[*]) to be 18°.86. Mayer's formula, however, which had been followed by almost all meteorologists up to this period, gives the temperature of this parallel 33°.8, being nearly 15° too high. Dr. Brewster, who had bestowed a good deal of attention on the subject of the mean temperature of the globe, even before the publication of Mr. Scoresby's results, was induced, from the comparison of Mayer's formula with observations on temperature made in high latitudes, to reject it as not being applicable to the phenomena. He found on investigation, that the temperature varied pretty nearly with the co-sine of the latitude, and obtained the general expression

$$T = 81°\tfrac{1}{2} \text{ cos. lat.}$$

T being the mean temperature of any place, and 81½° the mean temperature of the equator. This formula, applied to thirty different places, situated between the equator and latitude 65° 3′, agreed with the results determined by observation within $\frac{8}{10}$ths of a degree, at an average, upon each observation.[†] And applied to the Arctic parallels, it gives the temperature of 76° 45′, 18° 68′, differing only $\frac{18}{100}$ths of a degree from the temperature observed by Captain Scoresby. This striking coincidence, was indeed general in all places situated about the meridian of England and western Europe, but the formula required a modification for the new world; the mean temperature of the American continent, and the regions to the northward of it, being found to be lower than that of Europe. This is particularly the case in high latitudes. Thus, the thermometric curve of 17°, Dr. Brewster observes, which rises in the meridian of Spitzbergen to 78° of north latitude, descends in the meridian of Melville Island to 65°; and, we may add, that the 75th parallel at Spitzbergen, which has a mean temperature of about 20°, has, at Melville Island, as ascertained by Captain Parry with great accuracy, during twelve successive months, a mean temperature of zero, or one or two degrees below it. Hence Dr. Brewster concludes, and with the best reason imaginable, "that the pole of the globe is not the coldest point of the arctic hemisphere;" but "that there are *two points of greatest cold*, not many degrees from the pole, and in meridians nearly at right angles to that which passes through the west of Europe." These points Dr. Brewster supposes to be situated about the 80th parallel, and in the meridian of 95° east, and 100° west longitude. A general expression for calculating the temperature, applicable to all parts of the northern hemisphere, referring to these isothermal poles is,

$$\text{Mean temp.} = 86° \; 3 \text{ sin. D} - 3\tfrac{1}{2},$$

upon the supposition that the greatest cold is —3½° of Fahrenheit; "82° 8 being the mean temperature of the equator in the warmest meridian, and D the distance of the place from the nearest isothermal pole."[‡] This formula, applied to the conclusions obtained by Humboldt, and to the observations of Captain Scoresby and Captain Parry, gives very satisfactory and consistent results. And by the further application of this formula, the mean temperature of the north pole comes out 11°, which differs only one degree from the analogical result obtained by Captain Scoresby.[§] The near coincidence of the isothermal poles, and of the magnetic poles of the earth, led Dr. Brewster to suppose that they might have some other connexion besides their accidental locality. If so,—if the centres of greatest cold be also precisely the centres of magnetic attraction, and if from some unknown but necessary connexion they are always coincident, then we derive from the known motion of the magnetic poles, an explanation of some of the most remarkable revolutions that have taken place on the surface of the globe. "There is no fact in the natural history of the earth better ascertained," observes Dr. Brewster in his interesting paper that we have already quoted, "than that the climate of the west of Europe was much colder in ancient than in modern times. When we learn that the Tyber was often frozen;—that snow lay at Rome for forty days;—that grapes would not ripen to the north of the Cevennes;—that the Euxine Sea was frozen over every winter in the time of Ovid;—and that the ice of the Rhine and the Rhone sustained loaded waggons:—we cannot ascribe the amelioration of such climates to the influence of agricultural operations.

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[*] *Account of Arctic Regions*, Vol. I. Appendix, No. II.; and Vol. I. p. 358.

[†] *Edinburgh Philosophical Transactions for* 1820.

[‡] "The distance D from the isothermal pole is in the coldest meridian D = 80° latitude; and in the warmest meridian cos. D = cos. 10° × sin. lat. In all intermediate meridians, we have $\text{cos. D} = \frac{\text{cos. L} \, (\text{cos. } l - \theta)}{\text{cos. } \theta}$, and tang. θ cos. M. tan. L, where M is the difference of longitude between the place and the pole, L the co-latitude of the isothermal pole or 10°, and l the co-latitude of the place." Ibid.

[§] *Account of Arctic Regions*, i. 364.

"The cold meridian which now passes through Canada and Siberia, may then have passed through Italy; and if we transfer the present mean temperatures of these cold regions, to the corresponding parallels in Europe, we shall obtain a climate agreeing in a singular manner with that which is described in ancient authors.

"It is not, however, in the altered condition of our atmosphere merely, that we are to seek for proofs of a periodical rotation of climate. The impressions of the plants of warm countries, and the fossil remains of land and sea animals, which could exist only under the genial influence of the temperate zone, are found dispersed over the frozen regions of Eastern Asia; and there is scarcely a spot on the solid covering of the globe, that does not contain indications of a revolution in its animal and vegetable productions.

"This interchange of the productions of opposite climates, has been ascribed to some sudden alteration in the obliquity of the ecliptic, and even to a violent displacement of the earth's axis; but astronomy rejects such explanations, as irreconcileable with the present condition of the system, and as incompatible with the stability of the laws by which it is governed." *

In temperate and frigid climates, where the temperature is liable to sudden and considerable variations, we find the pressure of the atmosphere, as indicated by the barometer, to be also liable to rapid and great fluctuations. But as these fluctuations in the spring and autumn, when they are probably the greatest, have been little observed, we shall only mention the fact relating to this part of our subject, that the greatest changes of temperature and pressure often happen simultaneously, and are generally attended or followed by storms.

In proportion as we recede from the equator, we find the climate, as we have already observed, more changeable. This is the case as regards temperature, atmospheric pressure, and winds; the latter becoming more irregular, variable, and partial, as we approach the frigid zone, or the borders of the polar ices. Thus, at certain seasons, storms or calms repeatedly alternate, without warning or progression; forcible winds blow in one place, when at the distance of a few leagues gentle breezes prevail; a storm from the south, on the one hand, exhausts its impetuosity upon a gentle breeze, blowing from off the ice on the other, without prevailing in the least; ships within the circle of the horizon may be seen enduring every variety of wind and weather at the same moment; some under close-reefed topsails, labouring under the force of a storm; some becalmed and tossing about by the violence of the waves; and others plying under gentle breezes, from quarters as diverse as the cardinal points. † The cause of the principal of these phenomena is to be found in the frigorific influence of the ice, in producing unequal temperature in the air. They have, however, been only observed early in the spring and late in autumn, the winter and summer seasons being less irregular; and they only occur to their greatest extent near ice or land, and not in the main open ocean. As the sudden storms are particularly dangerous to the arctic navigator, it is of importance that he should be aware of their approach. The best indication is the barometer, which seldom or never fails to predict such gales. But there are other tokens, which are pretty certain. The most general preliminaries to these storms are perfect calm, or curiously variable breezes with strong squalls, and singular agitation of the sea; together with a heavy fall of thick snow; often changing from flakes to powder, and occasioning an astonishing gloominess and obscurity in the atmosphere. "If the snow suddenly clear away, the gale is often at hand, whilst a peculiar luminousness in the horizon sometimes points out its direction, and a noise in the upper regions of the atmosphere announces its approach. Some examples of the phenomena attendant on sudden storms are given by Captain Scoresby, in the work we have so often quoted. One or two of these we shall extract.

"In the evening of the 5th of April, 1811, latitude 70° 49′ N. and longitude 7° 15′ E. the wind blew a fresh gale from the northward, and the barometer, which had been stationary for thirty-five hours, stood at 29.88 inches. At noon, on the following day, we had a moderate breeze of wind from the north-west, which, towards evening, increased to a fresh gale, exceedingly variable and squally, accompanied by thick showers of flaky snow. At 9 A. M. the thermometer stood at 10°, at 4 P. M. it had risen to 17°, and at 6 P. M. to 27°. This remarkable rise of 17° of temperature in nine hours, indicated a southerly or easterly wind; and, because the barometer had fallen to 29.50, a severe storm was expected. Since the barometer stands highest on easterly winds, had it remained stationary we should have expected a storm, on the veering of the wind from the N. W. to the opposite quarter; but when this change was preceded by a fall of near four-tenths of an inch in the column of mercury, a violent gale might be anticipated.

"I now walked the deck, somewhat alarmed at the awful appearance of the sky, in the short intervals of the showers. At one time a luminousness resembling the ice-blink appeared in the horizon, extending from the N. N. E. to the E. S. E. It did not, however, proceed from any ice, as I was afterwards perfectly satisfied; neither was it likely to arise from the effects of the sun, as it was in a different quarter.

"In the midst of a thick shower, the snow was observed to clear away to leeward, which warned me of an approaching *shift* of wind. Immediately all hands were ordered on deck, to attend the sails, and every man at his station awaited the event. In about ten minutes the sails gave a violent shake, and were the next instant *taken flat aback*. The wind, though blow-

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* Dr. Traill, of Liverpool, in a recent ingenious investigation on the principles and phenomena of thermo-magnetism, submitted to the Royal Society of Edinburgh, maintains principles not only similar to those of Dr. Brewster, but applies them to the explanation of the change of position in the isothermal poles. Dr. Brewster inferred from the phenomena of temperature, that the present coincidence of the magnetic and isothermal poles is not an accidental circumstance, but a necessary consequence of some law or principle of nature. Recent discoveries are greatly in support of this idea; for it is clearly shown, that magnetic properties are developed in almost all bodies by unequally heating them. Hence Dr. Traill, with great propriety, argues that the earth itself is a great thermo-magnetic apparatus, the properties of which are developed by the disturbance of its equilibrium of temperature, by the perpetual action of solar heat on its equatorial regions, and the icy covering of its poles. From this principle it would be reasonably deduced, that any change taking place in the poles of cold ought to produce a corresponding change in the magnetic poles.

† Scoresby's *Account of the Arctic Regions*, vol. i. p. 397.

ing a fresh gale, veered in a moment from N.N.W. to E.S.E. We steered by the wind, after reefing sails, about an hour and a half to the north-eastward, when the snow began to abate, but the wind of a sudden became so violent, that the utmost exertions of all the crew were but just sufficient to prevent the sails from blowing to pieces. At length all was made snug; a close-reefed main-topsail, and storm try-sail, were alone exposed to the fury of the tempest. On the second day of the storm's continuance, a heavy sea struck the ship, and with dreadful violence mounted the deck; it had nearly precipitated a boat suspended from the weather quarter, over the rail,—it lifted and removed an eighteen pounder carronade,—filled two boats with water,—and stove or washed away the whole of the bulwark, fore and aft.

During the whole of this gale, which lasted three days, the barometer remained perfectly stationary.

On May 17, 1812, lat. 76° 7′, long. 9½° E. the ship which I commanded was immured among ice, and the wind blew a hard gale from the N.N.W. The day following it subsided, and a moderate breeze prevailed, veering from N.N.W. gradually to W., S., E., and finally settling again at N.N.W. after touching on every point of the compass. The barometer, meanwhile, was depressed. In the evening it was nearly calm. While we were in the act of towing the ship through a narrow opening between two floes, a heavy shower was observed in the N.W. advancing towards the ship. On its approach the vane at the mast-head whirled round, the sails were violently shaken, and in a moment the snow enveloped the ship in obscurity, and a violent storm of wind dashed her, spite of every exertion, stern first, against a floe of ice, which she was in the act of doubling. The concussion, though violent, was prevented by the prompt activity of the sailors, in getting out a rope to one of the adjoining sheets of ice, from producing any particular injury. After enduring considerable pressure from the two floes, which, at the same instant collapsed, we were enabled to make our escape from a situation of the most perilous nature, and happily without any serious damage being sustained by the ship.

May the 10th, 1813, the barometer indicated a storm; and the singular appearance of the atmosphere strengthened the indication. After twelve or eighteen hours of calm and variable weather, occasioned evidently by conflicting winds, a sudden and impetuous storm arose, which continued with little intermission for six days."

The approach of sudden storms, it has been observed, is sometimes announced by a noise in the air. Captain Scoresby, senior, once removed his ship from a most dangerous bight in the main ice, where she would probably have been lost, had she remained a few minutes longer, in consequence of his having heard the rushing of a storm in the air, when at the mast-head. Before the ship was out of danger, a heavy gale commenced; but the sails being set, and the ship under command, she was extricated from the perilous situation. From this circumstance he imagines, that sudden storms frequently commence at some height in the atmosphere, and gradually descend to the surface.

A phenomenon of a description similar to that of sudden storms, and almost equally common, is *intermitting gales*. The nature of these winds will be best explained by mentioning two or three instances.

"April the 22d, 1814, latitude 73° 29′," observes Captain Scoresby, "we had intermitting gales, snow-showers, and high sea. The squalls continued from five minutes to half an hour at a time; and the intervals of calm weather were a little longer. During the squalls the ship could only bear close-reefed topsails and courses, but in the intervals she might have carried royals. This kind of weather prevailed from 8 A. M. until 3 P. M. when, in a shower of snow, a sudden calm occurred, and continued for an hour. The gale then suddenly recommenced with increased severity. At 9 P.M. the wind veered at once from N.N.W. to E.N.E. and then subsided. From 9 to 12 P. M. a thickness of six inches of snow fell upon the deck.

"The morning of the 18th of April, 1815, in the 78th degree of latitude, near Spitsbergen, was beautifully clear and serene. At 11 A.M. clouds began to obscure the face of the sky, and soon afterwards much snow fell. In the evening we experienced fresh gales from two or three quarters, with intervals of calms, in the space of an hour. North, east, and south gales alternately prevailed, in rapid but irregular succession, during several hours. The winds not being dangerous, the phenomena were uncommonly interesting."

The following examples of local storms will afford a good illustration of the partial winds of the polar seas. Captain Scoresby, senior, when commanding the ship Henrietta, was on one occasion navigating the Greenland sea during a tedious gale, accompanied with snowy weather.

"As the wind began to abate, a ship appeared in sight, under all sails, and presently came up with the Henrietta. The master hailed, and inquired what had happened, that the Henrietta was under close-reefed topsails in such moderate weather. On being told that a storm had just subsided, he declared that he knew nothing of it; he observed, indeed, a swell, and noticed a black cloud a-head of his ship, that seemed to advance before him, until he was overshadowed with it a little while before he overtook the Henrietta; but he had had fine weather and light winds the whole day."

The last example we shall give occurred in the same seas in 1817.

"At noon of the 4th of May, the ship Esk under my command," observes Captain Scoresby, junior, "was in latitude 78° 55′, near the ice, with a brisk breeze of wind from the E.S.E. In the evening we stood to the southward, experienced a considerable increase of wind, and at midnight tacked. We then steered under a brisk sail to the N.E. as high as latitude 80° 10′, finding less wind and clearer sky as we went to the northward; while dense clouds appeared in the southern quarter, and a heavy swell from the same direction pursued us. The wind was light in the evening of the 5th; tacked at the edge of the northern ice, and returned to the south-westward. During the whole of the next day, we continued our course, under all sails, having a fresh breeze of wind at S.E. heavy southerly swell, and a constant fall of snow, consisting of the most beautiful crystals I ever saw. The day following we joined several ships, when the weather was calm and the sea fallen. We now were informed that, while we enjoyed fine weather in the latitude of 80°, the ships in the 79th degree of latitude, during two days, had experienced a most tremendous storm; in consequence of which, some whales that had been killed before the gale came on, were lost, and four ships that were driven into the ice were wrecked."

Such partial and sudden storms seldom occur after the middle of the month of May. In June and July the weather is generally moderate or calm; but in

September and October very tempestuous. In the interior of the ice, when the ice forms a close compact body, the winds are less violent than at the edge of the ice; in such situations, indeed, storms are very uncommon. And in winter, vessels frozen up have generally experienced fine calm weather for days and weeks together. Thus Crantz remarks, that in Disco it is often for two or three months constantly calm, and the air clear. And Dr. Guthrie, in his *Dissertation on the Climate of Russia*, remarks, that nature seems "to have studied a perfect equality in the distribution of her favours, as it is only the parts of the earth which most enjoy the kindly influences of the sun, that suffer by the effects of its superior heat, so that if the atmosphere of the north is not so genial as that of the south, at least it remains perfectly quiet and serene, without threatening destruction to man, and the product of his industry, as in what are commonly called happier climates."

Captain Parry, during his wintering at Melville Island, experienced a similar stillness in the atmosphere during the depth of winter, and severe colds, for it was not till the advance of spring that strong winds were experienced; and it was observed, that whenever the wind arose the temperature became more mild, from whatever quarter the wind blew. This was a strong proof that his place of wintering was near the coldest portion of the globe, otherwise a north wind, it might have been expected, would have been productive of a fall of temperature.

In icy regions, both within and without the arctic circle, the most prevalent direction of the wind is from the ice towards the open sea. In Hudson's Bay westerly winds blow for three-fourths of the year;* at Kamtschatka the prevailing winds are also from the westward;† in Greenland northerly winds occur during seven months in the winter‡; and in a similar proportion nearly, in Spitzbergen, Jan Mayen, and Nova Zembla, as far as the observations of adventurers who have occasionally wintered in these desolate countries, can enable us to draw general conclusions.

The prevalent winds in the Greenland sea, betwixt Spitzbergen and Greenland, are from the eastward or N.E. in March and April; from the northward in May and June; from the south and south-west in July and August; and from the south-eastward in September. The number of storms, in this quarter, during the month of April, is very great. On an average of from 6 to 12 years, 11 stormy days out of the 30 occurred in April, $6\frac{1}{10}$ in May, $3\frac{5}{10}$ in June, and $3\frac{1}{10}$ in July.§

The hardest gales, near Spitzbergen, in the spring of the year, are generally those from the north-east, east, and south-east. Those of March and April frequently blow without intermission for two or three successive days, and rarely subside until the wind veers round to the north or north-west. The south-westerly and southerly storms of the autumn blow with great fierceness in many parts of the Arctic regions; and the eastern coast of Greenland is subject at this season to tremendous gales from these and also from the northern quarters. In west Greenland, it is observed by Crantz, "when it once begins to be stormy, which happens mostly in autumn, the wind rages so vehemently, that the houses quiver and crack, the tents and lighter boats fly up into the air, and the sea-water scatters about on the land like snow-dust." ‖

There is very little *clear* weather in the Arctic *seas* during spring, summer and autumn; for while the atmosphere over the land is free from clouds and visible vapours, at sea it is generally obscured by frost-rime in the spring, and by clouds or fog in the summer. The *frost-rime* is a vapour which arises from the sea in severe frosts. It is occasioned by the warmth of the water comparatively with the temperature of the air. This difference of temperature produces a considerable evaporation, which the coldness of the air condenses in minute frozen particles as rapidly as it is produced. In calm weather the frost-rime is scarcely perceptible; but in high winds and heavy seas, when the different strata of air near the surface are intimately blended by the agitation of the waves, it rises to the height of 20 or 30 yards, and becomes as obscure and bewildering to the navigator as the densest fog. It affords him this advantage, however, that by being superficial he can get above it by ascending his ship's mast, from the summit of which he gains a much more clear and extended prospect.

In the interior of compact ice there is always a tendency to clear weather; but so soon as the ice separates, and the temperature rises to the freezing point, fogs become exceedingly frequent, and of extraordinary density. They sometimes prevail for days and weeks together without a moment's attenuation. There are intervals, however, of a perfectly cloudless sky, which sometimes extend to two or three successive days. And in all the regions far north, during the absence of the sun, clear frosty weather is almost universal. This was strikingly the case in the experience of Captain Parry at Melville Island, the sky being generally cloudless in the winter and spring. And it was observed, that when the clouds became gradually more dense and frequent the temperature began to rise.

Little snow falls in winter, and not much aqueous deposit in summer; but in spring and autumn there are prodigious falls of snow, particularly in gales of wind. Captain Parry experienced heavy snow-drifts in the month of October, "against which no human being could have remained alive after an hour's exposure." In Spitzbergen, which is frequented by Russian hunters from the borders of the White Sea, similar snow-drifts occur. If the hunters happen to be abroad when they occur, their lives are always in peril. Their usual practice, however, is to wrap themselves up in their large cloaks, and lying flat down on their faces, to await in this posture, for an interval of the storm in which they may recover their hut or tent. In this way they have a chance of escaping; but to contend against the severe and bewildering action of a snow-storm, is only prematurely to exhaust their strength and hasten their destruction. The snow which occurs during severe frosts is remarkable for the beauty of its crystals. The principal configurations are the stelliform and hexagonal, though almost every shape of which the generating angles of 60° and 120° are susceptible, may, in the course of a few years' observation, be discovered. Captain Scoresby has figured nearly a hundred varieties of snow-crystals observed by himself, some of them extremely beautiful, and all of them, however complex, perfectly symmetrical.*

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* Pennant's *Arctic Zoology*, *Supplement*, p. 41.

† Idem, *Arctic Zoology*, cxiii.

‡ Middleton's *Vindication*, p. 201.

§ Scoresby's *Arctic Regions*, i. 411.

‖ *History of Greenland*, i. p. 47.

Rain is not unfrequent in the months of July and August, and sometimes the quantity that falls in continued succession in a few days, is perhaps fully equal, for the time, to what occurs in tropical countries in the rainy season.†

The atmospheric phenomena of the Arctic regions are peculiarly curious and interesting. This is more especially the case with regard to the aurora borealis, haloes, parhelia, coronæ, and anthelia, and the optical effects of unequal refraction. As these various phenomena, however, are described under their respective appellations, in the course of this work, we shall only here state some few particulars respecting such as are more peculiar to the Arctic regions.

Haloes and parhelia were observed by Captain Parry, in his voyage to Melville island, in very great perfection and variety. Sometimes the parhelia and prismatic circles were numerous. The radius of the first halo is stated, at different times, to have been 21° 38′ from the sun, 22°, 22° 10′, 22° 20′, &c. On one occasion, there were two concentric prismatic circles, five segments of circles, and three bright parhelia, all exhibited at one time.‡ Sometimes similar phenomena, but less bright, were observed round the moon. On the 26th of January, there was a luminous circle encompassing the moon of 22° 40′ radius, and a white horizontal streak of light, forming prismatic spots of light, or paraselenæ, at the intersection with the halo. On another occasion there were two circles of 38° and 46° radius round the moon, and four paraselenæ on the inner one.

Coronæ and anthelia were observed by Captain Scoresby in the Greenland sea, almost daily in foggy weather, whenever the sun was visible. The best position for seeing them was at the mast-head, where the head of the shadow of the observer on the water was always encompassed with an anthelion or glory. Around this were several prismatic circles, from two to five in number, all concentric and opposite to the sun. The diameters were, No. 1, 1½° or 2°; No. 2, the (exterior limit) 4° 45′; No. 3, about 6° 30′; and No. 4, (the middle of the band,) about 38° 50′. The colours of some of these circles were vivid and distinct, but of others merely shades of a luminous grey.§

But the most amusing, perhaps, of all the optical phenomena observed in the Arctic regions, are those produced by unequal refraction. In the height of summer, when the sky is clear, the constant action of the sun produces a rapid evaporation from the sea and ice; but as the air, thus charged with moisture, passes over alternate surfaces of water and ice, it becomes of very unequal densities, forming various strata of different degrees of refractive power. Hence objects seen through such media are variously distorted—images are multiplied—the most fantastic forms are exhibited in an endless and ever varying succession. Captain Scoresby, in his voyage to Greenland in 1822, gives a number of examples of these interesting phenomena. On one occasion, there being a number of ships in sight at a time when the atmosphere, though clear, was in a very extraordinary condition, the appearances were particularly curious. "Of some vessels, whose hulls were beyond the horizon, there were two, and of one ship three, distinct inverted images, each exhibited in a different stratum of refracted ice, one above another,—the lowest image being at an altitude of more than the apparent height of the ship's mast, above the mast-head of the original. And of two vessels there were well-defined images, in an inverted position, though the ships to which they referred were not within sight! It should be observed, that the inverted images were visible on this occasion only, when an appearance of ice, produced either by reflection or refraction, occurred above the regular line of the horizon, in the quarter occupied by the ships. In the clear intervals of the lower atmosphere, between the strata of refracted ice, no image was seen; and when the stratum was too narrow to comprise the whole of the image, a part of it only appeared. And it should be also observed, that these phenomena were principally telescopic, both the ships and images being so distant, that, to the naked eye, they only appeared as indistinct specks. The inverted images occurred either in the south-west or north-east quarter; but, at the same time, the ships in the north-west quarter were only subject to a distortive influence—these appeared above a cliff of ice, elevated by refraction, like oblong black streaks, lengthened out, but compressed almost to the breadth of a line.

The land also exhibited some curious appearances. In many places there were patches resembling two obtuse pyramids united by their apices, the upper one, though quite as distinct as the other, being evidently the inverted image only of the lower one. In occasional positions, where two of these double pyramids were near together, the upper limbs of the higher pyramids coalesced, so as to present the appearance of prodigious bridges, some leagues in extent, with a clear atmosphere beneath them. Sometimes these pyramids were so compressed and multiplied, that three or four were seen in a vertical series, forming so many distinct horizontal strata, joining in the middle, but all detached at the extremities.

The general telescopic appearance of these arctic coasts, when under the influence of unequal refraction, is frequently that of an extensive ancient city, abounding with the ruins of castles, obelisks, churches, and monuments, with other large and conspicuous buildings. Some of the hills often appear to be surmounted with turrets, battlements, spires, and pinnacles; while others, subjected to another kind of refraction, exhibit large masses of rock, apparently suspended in the air, at a considerable elevation above the actual termination of the mountains to which they refer. The whole exhibition is frequently a grand and interesting phantasmagoria. Scarcely is the appearance of any object fully examined and determined, before it changes into something else. It is, perhaps, alternately a castle, a cathedral, or an obelisk: then expanding and coalescing with the adjoining mountains, it unites the intermediate valleys, though they may be miles in width, by a bridge of a single arch of the most magnificent appearance.

Among all the optical phenomena of unequal refraction which Captain Scoresby mentions, the most extraordinary appears to have been the discovery of his father's ship, when many miles beyond the reach of direct vision by its inverted image in the air. The account of this circumstance, by Captain Scoresby, who had just returned from his first landing on the east coast of Greenland, at Cape Lister, in latitude 70° 30′ N. is thus given in his Journal. "It was about 11 P.M. the night was beautifully fine, and the air quite mild. The atmosphere, in consequence of the warmth, being in a highly refractive state, a great many curious appearances were presented by the land and icebergs. The most extraordinary effect of this state of the atmosphere, however, was the distinct inverted image of a ship in the clear sky, over the middle of the large bay or inlet before mentioned,—the ship itself being entirely beyond the horizon. Appearances of this kind I have before noticed, but the peculiarities of this were,—the perfection of the image, and the great distance of the vessel that it represented. It was so extremely well defined, that when examined with a telescope by Dollond, I could distinguish every sail, the general "rig of the ship," and its particular character; insomuch that I confidently pronounced it to be my father's ship, the Fame, which it afterwards proved to be,—though, on comparing notes with my father, I found that our relative position at the time gave our distance from one another very nearly thirty miles, being about seventeen miles beyond the horizon, and some leagues beyond the limit of direct vision. I was so struck by the peculiarity of the circumstance, that I mentioned it to the officer of the watch, stating my full conviction that the Fame was then cruizing in the neighbouring inlet."

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* See *Account of the Arctic Regions*, vol. i. p. 425—432.

† See Scoresby's *Voyage to Greenland*, 1822.

‡ Parry's *Voyage to the North-West*, p. 152, 156, 157, 162, 163, 164, 172, &c.

§ *Voyage to the Northern Whale-fishery in* 1822, p. 274, 284.

Another effect of this state of the atmosphere is to render directly visible objects which in reality are entirely beyond the horizon. This takes place in some measure in temperate, and perhaps torrid, as well as in the frigid climates. But in the latter the exhibition of this phenomenon is more frequent and more remarkable than in any other region. Captain Scoresby gives several examples of it in his *Account of the Arctic Regions*, vol. i. pp. 384—391. But in his *Journal of a Voyage to Greenland*, the most singular example occurs. "The particulars were these: Towards the end of July 1821, being among the ice in latitude 74° 10′, and longitude, by lunar observation and chronometer, (which agreed to twenty-two minutes of longitude, or within six geographical miles,) 12° 30′ 15″ W. land was seen from the mast-head to the westward, occasionally, for three successive days. It was so distinct and bold, that Captain Manby, who accompanied me on that voyage, and whose observations are already before the public, was enabled, at one time, to take a sketch of it from the deck, whilst I took a similar sketch from the mast-head, which is preserved in my journal of that year. The land at that time nearest to us was Wollaston Foreland, which, by my late surveys, proves to lie in latitude 74° 25′ (the middle part of it,) and longitude 19° 50′: the distance, therefore, must have been at least 120 miles. But Home's Foreland, in 21° W. longitude, distinguished by two remarkable hummocks at its extremities, was also seen; its distance, by calculation, founded on astronomical observations, being 140 geographical, or 160 English miles. In an ordinary state of the atmosphere (supposing the refraction to be one-twelfth of the distance), any land to have been visible from a ship's mast-head, an hundred feet high, at the distance of 140 miles, must have been at least two nautical miles, or 12,000 feet in elevation; but as the land in question is not more than 3500 feet in altitude, (by estimation,) there must have been an extraordinary effect of refraction equal to 8500 feet. Now, the angle corresponding with an altitude of 8500 feet, and a distance of 140 miles, is 34′ 47″, the value of the extraordinary refraction, at the time the land was thus seen; or, calculating in the proportion of the distance, which is the most usual manner of estimating the refraction, it amounted to one-fourth of the arch of distance, instead of one-twelfth, the mean quantity.

That land was seen under these circumstances, there cannot be a doubt; for it was observed to be in the same position, and under a similar form, on the 18th, 23d, 24th, and 25th July, 1821, when the ship was in longitude from 12° 30′, to 11° 50′ W. and on the 23d it remained visible for twenty-four hours together; and though often changing its appearance, by the varying influence of the refraction, it constantly preserved a uniformity of position, and general similarity of character. In my journal of this day, I find I have observed, that my doubts about the reality of the land were now entirely removed, since, with a telescope, from the mast-head 'hills, dells, patches of snow, and masses of naked rock, could be satisfactorily traced, during four-and-twenty hours successively.' This extraordinary effect of refraction, therefore, I conceive to be fully established."

The only other optical phenomena that we shall describe, is the ice-blink. "On approaching a pack, field, or other compact aggregation of ice, the phenomenon of the *ice-blink* is seen whenever the horizon is tolerably free from clouds, and in some cases even under a thick sky. The *ice-blink* consists of a stratum of a lucid whiteness, which appears over ice in that part of the atmosphere adjoining the horizon. It appears to be occasioned thus: Those rays of light which strike on the snowy surface of the ice, are reflected into the superincumbent air, where they are rendered visible, either by the reflective property of the air, simply, or by a light haze, which, on such occasions, probably exists in the atmosphere; but the light which falls on the sea, is in a great measure absorbed, and the superincumbent air retains its native ethereal hue. Hence, when the ice-blink occurs under the most favourable circumstances, it affords to the eye a beautiful and perfect map of the ice, twenty or thirty miles beyond the limit of direct vision, but less distant in proportion as the atmosphere is more dense and obscure. The ice-blink not only shows the figure of the ice, but enables the experienced observer to judge whether the ice thus pictured be field or packed ice: if the latter, whether it be compact or open, bay or heavy ice. Field-ice affords the most lucid blink, accompanied with a tinge of yellow; that of packs is more purely white; and of bay-ice, greyish. The land, on account of its snowy covering, likewise occasions a blink, which is more yellow than that produced by the ice of fields."

SECT. VI.—*Phytology*.

Before we enter the arctic regions, we find the vegetable productions of the earth progressively diminishing in size and in number, as we recede from the equator. The noblest trees of the forest in temperate climes cannot vie in size with the vast *adansonia*, or the superb *palms* of the torrid regions, the giants of vegetable life: and, in advancing toward the poles, there is a striking diminution of the number of vegetable species. Wildenow states the number of known species on the Coromandel coast, and in the island of Jamaica, at 4000; in England 2592; in the Marquisate of Brandenburg 2000; in Sweden 1299; in Iceland 553; in Lapland 534;[*] in Spitzbergen, Captain Scoresby found 47 species;[†] and in Melville Island, probably the coldest point of the globe, Captain Parry has only noticed 12 or 13 species, among which the only shrubby plant was *Betula nana*, there a creeping vegetable, not rising two inches from the ground.[‡] Even in Lieutenant Franklin's arduous journey, which embraced a large portion of country below the 60th degree of latitude, and but a comparatively small track within the arctic circle, the number of plants observed, only amounts to 663 species.[§]

The physical distribution of vegetables has only of late years claimed due attention from the botanist, though it offers one of the most striking peculiarities of climate; but the researches of Wahlenberg, of Von Buch, and of Humboldt, have opened a noble field to botanical investigation. The observations of Wahlenberg, on their physical distribution in Lapland, forms so very complete a view of their general distribution in Arctic countries, that they may serve for a general sketch of the gradual extinction of vegetable life by approximation to the line of perpetual congelation. It is well known, that, besides latitude, the elevation of a country above the level of the sea, exerts a most important influence on its climate, because the limits of perpetual ice approach nearer and nearer to the sea as we advance toward the pole. Hence the Alpine regions of Lapland, to which Wahlenberg's observations apply, afford a favourable station for viewing the gradual influence of climate in circumscribing the Artic flora. He divides this district into eight zones, each marked by peculiarities in its vegetable productions.

1st, On approaching the Lapland Alps, we arrive at the line where the spruce fir *(Pinus abies)* ceases to grow. It had previously assumed the appearance of a slender pole, beset with short drooping branches, of a funereal hue. With the spruce fir, the *Rosa cinnamomea*; and *Convallaria bifolia*, had disappeared; and the borders of the pools were stript of *Arundo phragmites*, *Lysimachia thyrsifolia*, *Galium boreale*, and *Carex globularis*: This is the true region of *Tussilago nivea*. The extreme boundary of the spruce fir is 3200 below the level of perennial snow, where the mean temperature is 37°.5 Fahrenheit.

2d, Region. Here the Scotch fir, (*Pinus sylvestris*) though diminished in size, is still found, with a low stem and spreading branches; and here we lose *Ledum palustre*, *Salix pentandria*, *Veronica serpullifolia*. Near the extreme boundary of the Scotch fir, is found *Phaca alpina*. Beyond this the fruit of *Vaccinium myrtillus* does not perfectly ripen: the upper limit of this region is 2800 feet below the line of perpetual snow, and has a mean temperature of 36° 5′. About 600 feet lower, barley, one of the most hardy of the *Cerealia* ceases to ripen; though the potato and turnip are not too diminutive to afford a profitable crop, almost to the extremity of this zone.

3d, Beyond this the miniature forests consist of stunted birch, (*Betula alba*) which soon becomes so low as to be commanded from the most trifling eminence. Its upper boundary, where it is not above five feet in height, is 2000 feet below the line of perpetual snow. In this zone the *Alnus incana*, *Prunus padus*, *Populus tremula*, are early lost; and near its upper boundary, we miss the *Sorbus aucuparia*, *Rubus arcticus*, and common heath, *Erica vulgaris*; but the vegetation of *Sonchus alpinus*, and *Aconitum lycoctonum*, are very luxuriant, as well as of the *Lichen rangiferinus*, or reindeer moss, on the drier spots. At the upper limit of this zone, the *Tussilago frigida*, and *Pedicularis sceptrum carolinum*, disappear.

4th, The next zone contains brushwood, only on the margins of the streamlets, or in bogs, consisting of *Salix glauca*, and *Betula nana*, (which still retains its erect posture) intermixed here and there with a few bushes of juniper and *Salix hastata*. Every hillock is covered with *Arbutus alpina*, variegated with *Andromeda cærulea* and *Trientalis Europæa*, while the bogs are ornamented with *Andromeda polyfolia* and *Pedicularis Lapponica*. On the southern declivities we find *Veronica alpina*, *Viola biflora*, *Pteris crispa*, and *Angelica archangelica*. The upper branch of this zone is 1400 feet below the line of perpetual snow.

5th, In this region brushwood is no longer seen. The woolly willow, *Salix lanata*, is not more than two feet high, even in the most favourable situations; and *Salix myrsinitis* is still less. *Betula nana* now only creeps along the ground in the drier spots; but the hills are clothed with the humble, but vigorous vegetation of *Azalea procumbens*, and *Azalea Lapponica*, which impart a peculiar brownish hue to this zone. Sheltered spots between the rocks, it is true, afford specimens of *Lychnis apetala*, *Erigeron uniflorum*, and *Optrys alpina*; and in bogs may be seen *Aira alpina*, *Carex ustulata*, and *Vaccinum uliginosum*; but the only berries that here ripen are those of *Empetrum nigrum*, which luxuriates in this region. This zone extends to within 800 feet of the line of perpetual snow, and its mean temperature = 34° Fahrenheit; a little above this point we lose the *Lichen rangiferinus*.

6th, This region is marked by patches of perennial snow, the bare spaces between which are thinly sprinkled with the dark vegetation of *Empetrum nigrum*, now destitute of fruit; *Andromeda tetragona*, *A. hypnoides*, and *Diapensia Lapponica*, a few southern slopes are decorated with *Gentiana tenella*, *G. nivalis*, *Campanula uniflora*, and *Draba alpina*; while the marshes afford *Pedicularis hirsuta*, *P. flammea*, and *Dryas octopetala*. The superior limit of this zone is 200 feet below the line of perpetual and almost uninterrupted snows.

7th, Beyond the last region the general covering of snow is only interrupted by a few dark spots, occasioned by reflected heat, where the spongy surface of the soil affords sustenance to *Saxifraga stellaris*, *S. oppositifolia*, *S. rivularis*, *Ranunculus nivalis*, *R. glacialis*, *Rumex digynus*, *Juncus curvatus*, and *Silene acaulis*. The mean temperature of this zone, which touches the line of uninterrupted snow, is a little above 32° Fahrenheit.

8th, When some mass of dark rock occasions the melting of the snow in a few points of this zone, a few shoots of *Ranunculus glacialis*, and other similar plants occasionally show themselves, even to the height of 500 feet above the general line of perennial snow, until the point of perpetual congelation arrests the farther efforts of animated nature. The only living creature found in this dreary region, is the snow bunting, *Emberiza nivalis*.

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[*] *Flora Lapponica.*

[†] *Arctic Regions.*

[‡] Parry's *Voyage.*

[§] In this journey, Dr. Richardson, who was naturalist to the expedition, remarked the gradual extinction of some species of plants, and the diminution in the height of the trees as they advanced toward the shores of the Icy Sea: and they observed no trees above Lat. 67° 30′ N. in Long. 116° W. though they attained to latitude 68° 18′.

This division into zones, distinguished by their vegetable inhabitants, may be traced even along the surface of the lowest land, as we proceed northward; though there are so many circumstances which affect the temperature of any place, that the zones cannot be marked by fixed degrees of latitude; and the *isothermal* lines do not correspond with such parallels. The varieties of vegetable life decrease as we advance into the Arctic regions; and we find a proportionate diminution in the numbers of the larger animals.

SECT. VII.—*Zoology.*

Zoology.

In viewing the zoology of the Arctic regions, we find the number of species in the animal kingdom gradually diminish. These desolate regions, however, teem with life as far as human enterprize has hitherto penetrated. We have already noticed the innumerable myriads of animalcules which swarm in the deep, sufficient to discolour the waters of the Greenland sea to a vast extent, and which probably afford food to the small *squillæ,* and other *crustacea,* on which the huge *mysticetus* is supported. This exuberance of animal life is the cause of the vast numbers of some species of aquatic fowl, visiting the Arctic circle to the very limits of perpetual congelation. Even the scanty vegetation of high latitudes is capable of supporting many animals. The rein-deer, the musk-ox, the ptarmigan, grow fat amid the stinted vegetation of Melville Island, during its short summer; after which an admirable instinct warns them to retreat to more genial climes.

The *Fauna Groenlandica* of Fabricius, a Danish missionary, some time resident in that colony, affords the best connected view of the zoology of an Arctic country yet given to the world.

Of the lower animals he enumerates and describes,

Vermes, including Testacea, . .	228
Insecta, including Articulata, . .	110
Pisces, including Cartilaginei, . .	44
True Amphibia, *(rana temporaria,)* .	1
Aves, ...	53
Mammalia, ...	32
	468

—no inconsiderable list for so dreary a country.

The more recent investigations of Captains Phipps, Scoresby, and Sabine, have made us acquainted with several additional inhabitants of the Greenland sea, or the adjacent shores, as may be seen by the following list:

Vermes.

Flustra pilosa.
Cellipora pumicosa.
Sabella frustulosa.
Buccinum carinatum.
Mytilus rugosus
Asterias pectinata.
Medusa pileus, and six other small species, described and figured by Scoresby.—Arctic Regions.
Six species of minute *animalcula,* described and figured by Scoresby.
Clio borealis.
helicina.

Articulata.

Cancer nugax.
ampulla.
boreas.
pulex.
arcticus.

Pisces.

Gadus carbonarius.
Mulbus barbatus.
Squalus borealis.

Aves.

Hirundo riparia. In Melville Island.
Tringa hypoleucos.
cinerea.
Charadrius pluvialis.
Uria brunnichii.
Larus argentatus.
sabini.

Mammalia.

Mus Groenlandicus. A new species, discovered on the east coast of Greenland by Scoresby.

It is, however, obvious, that these sources alone can only afford a tolerable view of the principal zoological productions of the Arctic regions.

Pennant's *Arctic Zoology* contains a description of many animals, which, strictly speaking, do not belong to countries even within the 60° of latitude. The work was originally intended to embrace the zoology of the whole of North America, and, therefore, it contains numerous animals that are only found in warm latitudes. The zoology of the northern parts of Europe and Asia have been ably illustrated in the works of Linnæus and Pallas; and many additions were made by the voyages of Steller and Cooke, and the researches of Sir Charles Giesecké. It is gratifying to our nationality to perceive how much the natural history of the Arctic regions is indebted to British enterprize. The voyages of Phipps, Scoresby, Ross, Parry, Franklin; Sir Alexander Mackenzie, and Hearne, in America; of Sir G. Mackenzie, Dr. Hooker, and Dr. Henderson, in Iceland, are monuments of our enterprize and our zeal. From an examination of the facts collected in their writings, from various detached memoirs on the subject of natural history, and the perusal of some of the most eminent systematic writers, we have drawn up a catalogue of the animals in the classes *Mammalia, Aves,* and *Pisces,* which have been observed within the 60th degree of north latitude. We have fixed on this latitude, because it includes those regions of Asia and America where the intensity of the cold is fully as severe as within the polar circle in Europe; and it comprehends the whole of Greenland; a country which affords the best example of an Arctic Fauna.

MAMMALIA.

1.	Ursus maritimus,	Polar bear.
2.	Americanus,	Black bear and yellow bear, Richardson.
3.	cinereus,	Grizzly bear. Ditto.
4.	gulo,	Glutton.
5.	luscus,	Wolverene.
6.	Meles Labradoria,	American badger.
7.	Viverra martes,	Pine martin.
8.	erminea,	Stoat.
9.	zibellina,	Sable.
10.	Pennantii,	Fisher weesel.
11.	mephitis,	Skunk.
12.	Lutra marina,	Sea otter.
13.	Canadensis,	Canadian otter.
14.	Phoca barbata,	Great seal.
15.	fœtida,	Fœtid seal.
16.	hispida,	Rough seal.
17.	Groenlandica,	Harp seal.
18.	leporina,	Leporine seal.
19.	ursina,	Ursine seal.
20.	Leonina,	Leonine seal.
21.	vitulina,	Common seal.
22.	Canis familiaris,	Domestic dog.

23.	Canis lupus,	Wolf.
24.	lupus griseus,	Grey wolf.
25.	albus,	White wolf.
26.	vulpes,	European fox.
27.	fulvus,	Red fox.
28.	decussatus,	Cross fox.
29.	argentatus,	Silvery or black fox.
30.	cinereo-argentatus	Grizzled fox.
31.	lagopus,	Arctic fox.
32.	Felis domestica,	Common cat.
33.	Canadensis,	Canadian lynx.
34.	Sorex araneus,	Common shrew.
35.	moschatus,	Musk shrew.
36.	Histrix dorsata,	Canadian porcupine.
37.	Castor fiber	Beaver.
38.	Fiber zibethicus,	Musk rat.
39.	albus,	White musk rat.
40.	Mus Hudsonicus,	Hudson's Bay lemming.
41.	Groenlandicus,	Greenland lemming.
42.	Labradorius,	Labrador mouse.
43.	lemmus,	Common lemming.
44.	rutilus,	Red mouse.
45.	torquatus,	Ringed mouse.
46.	arvalis-Hudsonicus,	Hudson's Bay meadow mouse.
47.	tchelag,	Kamtschatka mouse.
48.	rattus,	Black rat.
49.	amphibius,	Water rat.
50.	Canadensis,	Canada rat.
51.	œconomicus,	Economic rat.
52.	Arctomys empetra,	Quebec marmot.
53.	pruinosa,	Hoary marmot.
54.	citillus,	Variegated marmot.
55.	Franklinii,	Grey American marmot. Richardson.
56.	Richardsonii,	Tawny American marmot. do.
57.	Hoodii,	Striped American marmot. do.
58.	Sciurus Hudsonius,	Hudson's Bay squirrel.
59.	vulgaris,	Common squirrel.
60.	volans,	European flying squirrel.
61.	sabrinus,	North American flying squirrel.
62.	Lepus variabilis,	Varying hare.
63.	Alpina,	Alpine hare.
64.	glacialis,	Polar hare.
65.	Americanus,	American hare.
66.	Cervus alces,	Elk, and various moose deer.
67.	tarandus,	Rein deer.
68.	Americanus,	American stag.
69.	alter,	A new species.
70.	tertius,	Ditto.
71.	pygargus,	Tailless roe.
72.	capreolus,	Roe ?
73.	Antilope furcifer,	Pong-horned antelope.
74.	Moschus moschatus,	Tibetian musk.
75.	Capra hircus,	Domestic goat.
76.	Ovis aries,	Common sheep.
77.	ammon,	Argali.
78.	Bos Americanus,	American buffalo.
79.	moschatus,	Musk ox.
80.	taurus,	Domesticated in some arctic countries.
81.	Trichechus rosmarus,	Walrus.
82.	borealis,	Whale-tailed walrus.
83.	Monodon monoceros,	Narwal.
84.	spurius,	Fabricius's narwal.
85.	Balæna mysticetus,	Greenland whale.
86.	physalus,	Fin-backed whale.
87.	musculus,	Round lipped whale.
88.	boops,	Pike-headed whale.
89.	rostrata,	Rostrated whale.
90.	gibbosa,	Bunched whale ?
91.	Physeter macrocephalus,	Blunt-headed cachalot.
92.	catodon,	Small cachalot.
93.	microps,	Small-eyed cachalot.
94.	tursio,	High-finned cachalot.
95.	Delphinus phocæna,	Porpesse.
96.	delphis,	True dolphin.
97.	deductor.	Drove whale.
98.	orca,	Grampus.
99.	nasutus,	Bottle-nosed dolphin.
100.	leucas,	Beluga.

AVES.

1.	Falco chrysætos,	Golden eagle.
2.	albicilla,	Cinereous, or sea eagle.
3.	fulvus,	Ring-tailed eagle.
4.	haliætus,	Osprey eagle.
5.	leucocephalus,	White-headed eagle.
6.	leucogaster ?	White-bellied eagle ?
7.	gerfalco,	Jerfalcon, including lanner.
8.	peregrinus,	Peregrine falcon, including many varieties of the common falcon.
9.	lagopus,	Rough-legged falcon.
10.	Novæ Terræ,	Newfoundland falcon.
11.	palumbarius,	Goshawk.
12.	borealis,	Red-tailed falcon.
13.	buteo,	Buzzard.
14.	obsoletus,	Plain falcon.
15.	Cayaneus,	Hen-harrier and ring-tail.
16.	Columbarius,	Pigeon hawk.
17.	uliginosus,	Marsh hawk.
18.	hiemalis,	Winter falcon.
19.	Strix bubo,	Eagle owl, including the Lapland owl.
20.	otus,	Long-eared owl.
21.	brachyotus,	Short-eared owl.
22.	nyctea,	Snowy owl.
23.	Wapacuthu,	Wapacuthu owl.
24.	fuliginosa,	Sooty owl.
25.	nebulosa,	Barred owl.
26.	sylvatica,	Brown and tawny owl.
27.	Hudsonia,	Hawk owl.
28.	flammea,	Barn owl.
29.	passerina,	Little owl.
30.	Lanius excubitor,	Great cinereous shrike.
31.	borealis,	Northern shrike.
32.	Corvus corax,	Raven.
33.	Hudsonius,	Hudson's Bay magpie. Richardson.
34.	corone,	Carrion crow.
35.	cornix,	Hooded crow.
36.	cristatus,	Blue jay.
37.	Canadensis,	Canadian jay.
38.	pica,	Common magpie.
39.	Stelleri,	Steller's crow.
40.	Oriolus Phœniceus,	Red-shouldered oriole.
41.	Baltimore,	Baltimore oriole.
42.	niger,	Black oriole.
43.	leucocephalus,	White-headed oriole.
44.	feriugineus,	Rusty oriole.
45.	virescens,	Yellow-throated oriole.
46.	Unalaschkæ,	Unalaschka oriole.
47.	Gracula quiscula,	Purple grackle.
48.	Cuculus canorus,	Common cuckoo.
49.	Yunx torquilla,	Wry neck.
50.	Picus martius,	Great black woodpecker.
51.	auratus,	Golden-shafted woodpecker.
52.	Canadensis,	Canadian woodpecker.
53.	flaviventris,	Yellow-bellied woodpecker.
54.	varius,	Spot-bellied woodpecker.
55.	pubescens,	Downy woodpecker.
56.	villosus,	Hairy woodpecker.
57.	viridis,	Green woodpecker.
58.	Norvegicus,	Norwegian woodpecker.
59.	minor,	Lesser-spotted woodpecker.
60.	Tridactyla hirsuta, vel P. Tridactylus,	Downy tridactyla.
61.	Alcedo alcyon,	Belted kingfisher.
62.	Sitta Europæa,	European nuthatch.
63.	Canadensis,	Canadian nuthatch.
64.	Sturnus vulgaris,	Common stare.
65.	ludovicianus vel torquatus,	Crescent stare.
66.	migratorius	Red-breasted stars.
67.	Cinculus Europæus,	Water ouzel.
68.	Turdus migratorius,	Red-breasted thrush.
69.	melodes,	Wood thrush, or wood robin.
70.	iliacus,	Red-winged thrush.
71.	pilaris,	Fieldfare ?
72.	Unalaschkæ,	Unulaschka thrush.
73	Labradorus,	Labrador thrush.

Polar Regions.

74.	Hudsonicus,	Hudson's Bay thrush.
75.	torquatus,	Ring thrush.
76.	Muscicapa atricapilla,	Pied flycatcher.
77.	ruticella,	American flycatcher.
78.	Canadensis,	Canadian flycatcher.
79.	striata,	Striped flycatcher.
80.	Sibirica,	Dun flycatcher.
81.	Hirundo riparia,	Sand martin.—*Melville Island.*
82.	bicolor,	Black and white swallow.
83.	purpurea,	Purple saveall.
84.	Unalaschkensis,	Unalaschka swallow.
85.	Alauda alpestris,	Shore lark.
86.	arvensis,	Sky lark.
87.	Motacilla alba,	White wagtail.
88.	Tschutschensis,	Tschutschi wagtail.
89.	Hudsonica,	Hudsonian wagtail.
90.	citreola,	Yellow-headed wagtail?
91.	Vitiflora œnanthe,	White rumped wheatear.
92.	Sylvia æstiva,	Yellowpole warbler.
93.	Awatcha,	Awatcha warbler.
94.	Parus Hudsonicus,	Hudsonian titmouse.
95.	bicolor,	Toupet titmouse.
96.	palustris,	Marsh titmouse.
97.	atricapillus,	Canada titmouse.
98.	major,	Great titmouse.
99.	ater,	Cole titmouse.
100.	Cayanus,	Azure titmouse.
101.	Fringilla montana,	Tree finch.
102.	Lulensis,	Lulean finch.
103.	Nortonensis,	Norton finch.
104.	iliaca,	Swamp finch.
105.	Lapponica,	Lapland finch.
106.	cannabina,	Common linnet.
107.	linaria,	Red-head linnet.
108.	montium,	Twite.
109.	flavirostris,	Arctic finch.
110.	cinerea,	Cinereous finch.
111.	Emberiza pecoris,	Cowper bird.
112.	nivalis,	Snow bunting; including Tawny and mountain bunting.
113.	leucocephalus,	White-crowned bunting.
114.	arctica,	Arctic-American bunting.
115.	aureola,	Yellow-breasted bunting.
116.	Unalaschkæ,	Unalaschka bunting.
117.	pithyornus,	Pure bunting.
118.	Crucirostra vulgaris,	Common cross-bill.
119.	leucoptera,	White-winged cross-bill.
120.	Loxia enucleator,	Pine grosbeak.
121.	Hudsonica,	Hudsonian grosbeak.
122.	Ludoviciana,	Red-breasted grosbeak.
123.	pyrrhula,	Bullfinch.
124.	septentrionalis,	Northern grosbeak.
125.	Tetrao umbellus,	Ruffed grous.
126.	urogallus,	Wood grous.
127.	phasianellus,	Long-tailed grous.
128.	cupido,	Pinnated grous.
129.	Canadensis,	Canadian grous.
130.	bonasia,	Hazel grous.
131.	Lapponicus,	Rehusbac grous.
132.	tetrix,	Black grous.
133.	medius,	Hybrid grous.
134.	saliceti, vel albus,	White grous.
135.	tetrao Scoticus,	Red grous.
136.	rupestris,	Rock grous.
137.	coturnix,	Quail.
138.	lagopus,	Ptarmigan.
139.	borealis,	Northern partridge.
140.	Columba migratoria,	Passenger pigeon.
141.	Ardea Americana,	Hooping crane.
142.	grus,	Common crane.
143.	Canadensis,	Brown crane.
144.	lentiginosa,	American bittern.
145.	major,	Common heron?
146.	Hudsonia,	Red-shouldered heron.
147.	gigantea vel leucogeranos,	Siberian crane.
148.	Scolopax arquata,	Common curlew.
149.	phæopus,	Whimbrell.
150.	borealis,	Esquimaux curlew.
151.	rusticola,	Woodcock.
152.	media,	Great snipe.
153.	gallinago,	Common snipe.
154.	Scolopax gallinaria,	Finmark snipe.
155.	gallinula,	Jack snipe.
156.	feoda,	Alicouan godwit.
157.	ægocephala,	Common godwit.
158.	marmorata,	Marbled godwit.
159.	Lapponica,	Red godwit.
160.	limosa,	Lesser godwit.
161.	Hudsonia,	Hudsonian godwit.
162.	glottis,	Greenshank.
163.	totanus,	Spotted snipe.
164.	calidris,	Redshank.
165.	vocifera,	Stone, or tell-tale snipe.
166.	flavipes,	Yellow shank.
167.	nutans,	Nodding snipe.
168.	nigra,	Black snipe.
169.	fusca,	Dusky snipe.
170.	melanura,	Black-tailed snipe.
171.	grisea,	Brown or red-breasted snipe.
172.	Tringa pugnax,	Ruff.
173.	gambetta,	Gambet.
174.	ochropus,	Green sandpiper.
175.	glareola,	Wood sandpiper.
176.	maritima,	Selinger sandpiper.
177.	undata,	Waved sandpiper.
178.	calidris,	Dusky sandpiper.
179.	punctata,	Freckled sandpiper.
180.	striata,	Striated sandpiper.
181.	cinerea,	Ash-coloured sandpiper.
182.	hypoleucos,	Common sandpiper.
183.	macularia,	Spotted sandpiper.
184.	borealis,	Boreal sandpiper?
185.	alpina,	Dunlin. and Purre.
186.	pusilla,	Little sandpiper.
187.	Islandica,	Iceland or red sandpiper.
188.	uniformis,	Uniform, perhaps a bird in its first plumage.
189.	Canutus,	Knot.
190.	interpres,	Turnstone.
191.	Vanellus gavia,	Crested lapwing.
192.	melanogaster,	Grey plover, or squattarole.
193.	Charadrius pluvialis,	Golden plover, and alwargrim plover.
194.	Hudsonius,	Hudsonian plover.
195.	calidris,	Sanderling.
196.	hiaticula,	Ringed plover.
197.	vociferus,	Noisy plover.
198.	morinellus,	Dottrel.
199.	Hæmatopus ostralegus,	Oyster catcher.
200.	Rallus aquaticus,	Water rail.
201.	Gallinula Carolina,	Soree gallinule.
202.	porzana,	Spotted gallinule.
203.	Fulica atra,	Common coot.
204.	aterrima,	Greater coot.
205.	Americana,	American coot.
206.	Phalaropus hyperboreus,	Red phalarope.
207.	glacialis,	Grey phalarope and plain phalarope.
208.	Americanus,	Wilson's phalarope.
209.	platyrynchus,	Flat-billed phalarope.
210.	Podiceps cristatus,	Crested grebe.
211.	auritus,	Eared grebe.
212.	cornutus,	Horned grebe.
213.	rubricollis,	Red-necked grebe.
214.	Carolinensis,	Pied-bill grebe.
215.	Recurvirostra Americana,	American avocet.
216.	Diomedea exulans,	Wandering albatross.
217.	Alca impennis,	Great auk.
218.	cirrhata,	Tufted auk.
219.	arctica,	Puffin.
220.	Labradoria,	Labrador auk.
221.	torda,	Razor-bill.
222.	pica,	Black-billed auk.
223.	alle,	Little auk.
224.	cristatella,	Crested auk.
225.	tetracula,	Dusky auk.
226.	psittacula,	Parrakeet auk.
227.	antiqua,	Ancient auk.
228.	platyrynchus,	Flat-billed auk, or pigmy.
229.	Uria Troile,	Foolish guillemot.
230.	Brunichii,	Brunich's guillemot.
231.	grylle,	Black guillemot.
232.	marmorata,	Marbled guillemot.

233.	Uria minor,	Lesser guillemot.
234.	Colymbus glacialis,	Northern Diver.
235.	immer,	Immer.
236.	arcticus,	Loom, or black threated diver.
237.	septentrionalis,	Red throated diver.
238.	Hudsonius,	Striped diver.
239.	Sterna hirundo,	White tern, or common tern.
240.	Caspia,	Caspian tern.
241.	fissipes, vel nigra,	Black tern.
242.	arctica,	Arctic tern, (different from common.)
243.	Larus marinus,	Black-backed gull.
244.	fuscus,	Herring gull, including the wagel.
245.	glaucus,	Glaucous gull, or burgomaster.
246.	argentatus,	Silvery gull.
247.	eburneus,	Ivory gull.
248.	ridibundus,	Black-headed gull.
249.	rissa,	Kittiwake.
250.	atricilla,	Laughing gull.
251.	Sabini,	Sabine's gull.
252.	canus,	Common gull ?
253.	minutus,	Little gull.
254.	Cataractes skua,	Skua gull.
255.	Lestris parasiticus,	Parasitic gull.
256.	Procellaria gigas,	Giant petrel.
257.	kurileus,	Kurile petrel.
258.	glacialis,	Fulmar.
259.	puffinus,	Shearwater.
260.	nigripes,	Black-toed petrel.
261.	forficata,	Fork-tailed petrel.
262.	pelagica,	Stormy petrel.
263.	Mergus merganser,	Goosander.
264.	serrator,	Red-breasted merganser.
265.	cucullatus,	Hooded merganser.
266.	castor,	Dun diver.
267.	albellus,	Smew.
268.	minutus,	Little merganser.
269.	Anas cygnus,	Wudling or wild swan.
270.	mutus, vel mansuetus,	Tame or mute swan.
271.	hyperboreus,	Snow goose.
272.	grandis,	Great goose.
273.	cygnoides,	Chinese goose.
274.	Canadensis,	Canadian goose.
275.	ruficollis,	Red-breasted goose.
276.	anser,	Grey lag goose.
277.	albifrons,	White-fronted goose.
278.	segetum,	Bean goose.
279.	Bering,	Bering goose.
280.	Guland,	Guland goose.
281.	erythropus,	Bernacle goose.
282.	bernicla,	Brent goose.
283.	cœrulescens,	Blue-winged goose.
284.	rutila,	Ruddy duck.
285.	mellissima,	Eider duck.
286.	spectabilis,	King duck.
287.	perspicillata,	Spectacle or black duck.
288.	nigra,	Scoter duck.
289.	fusca,	Velvet duck.
290.	histrionica,	Harlequin duck.
291.	boschas,	Mallard, including the tame duck.
292.	Labradoria,	Pied duck.
293.	marilla,	Scaup duck.
294.	tadorna,	Shieldrake.
295.	clypeata,	Shoveler.
296.	strepera,	Gadwall.
297.	falcaria,	Falcated duck.
298.	ferina,	Pochard.
299.	Americana,	American wigeon.
300.	acuta, vel hiemalis,	Pintail duck.
301.	glacialis,	Long-tailed duck.
302.	Stelleri,	Steller's or western duck.
303.	albeola,	Buffel-headed duck.
304.	clangula,	Golden-eye duck.
305.	glaucion,	Morillion duck.
306.	fuligula,	Tufted duck.
307.	Islandica,	Red crested Iceland duck.
308.	sponsa,	Summer duck. (Franklin, Cumberland house.)
309.	querquedula,	Gargeny.
310.	Anas crecca,	Common teal.
311.	crecca Americana,	American teal.
312.	discors,	Blue-winged teal.
313.	Pelecanus carbo,	Corvorant.
314.	graculus,	Common shag.
315.	cristatus,	Crested shag.
316.	violaceus,	Violet shag.
317.	urile,	Red-faced shag.
318.	Bassanus,	Gannet.
319.	onocrotalus,	Brown corvorant.

PISCES.

1.	Petromyzon fluviatilis,	Lamprey.
2.	Gasterobranchus cæcus,	Blind hag, or Myxine glutinosa.
3.	Raja batis,	Skate.
4.	oxyrynchus,	Sharp-nosed ray.
5.	probably several other rays.	
6.	Squalus carcharius,	White shark.
7.	maximus,	Basking shark.
8.	borealis,	Greenland shark, (Scoresby.)
9.	pristis,	Saw fish ?
10.	acanthius,	Piked dog-fish.
11.	catulus,	Spotted and panther shark.
12.	Chimæra borealis,	Northern chimera.
13.	Accipenser, (Sturio.)	Sturgeon ?
14.	Cyclopterus lumpus,	Lump sucker.
15.	pyramidatus,	Pyramidal sucker.
16.	gelatinosus,	Gelatinous sucker.
17.	ventricosus,	Ventricose sucker.
18.	liparis,	Unctuous sucker.
19.	lineatus,	Lineated sucker.
20.	minutus,	Small sucker.
21.	Syngnathus ophidion,	Snake pipe fish.
22.	typhle,	Small pipe fish.
23.	acus,	Greater pipe fish.
24.	Anguilla vulgaris,	Common eel.
25.	conger,	Conger eel.
26.	Ammodytes tobianus,	Sand launce.
27.	Anarichias lupus,	Wolf-fish.
28.	minor,	Smaller wolf-fish.
29.	Ophidium viride,	Green ophidium.
30.	Gadus morhua,	Cod.
31.	æglifinus,	Haddock.
32.	callarias,	Dorse.
33.	barbatus,	Whiting pout.
34.	minutus,	Poor.
35.	merlangus,	Whiting.
36.	carbonarius,	Coal fish.
37.	pollachius,	Pollack.
38.	virens,	Green gadus.
39.	merluccius,	Hake.
40.	molva,	Ling.
41.	lota,	Brarbot.
42.	brosme,	Torsk.
43.	Blennius gunnellus,	Gunnel blenny.
44.	lumpenus,	Areolated blenny.
45.	rancinus,	Frog blenny.
46.	punctatus,	Punctated blenny.
47.	viviparus,	Viviparous blenny.
48.	Coryphæna rupestris,	Rock coryphene.
49.	Cottus cataphractus,	Mailed bullhead.
50.	scorpius,	Lasher bullhead.
51.	quadricornis,	Four-horned bullhead.
52.	hexicornis,	Six-horned bullhead.
53.	gobio,	River bullhead.
54.	Zeus gallus ?	Indian dory, (Fabricius.)
55.	Pleuronectes hippoglossus,	Halibut.
56.	cynoglossus,	Smaller halibut.
57.	platessoides,	Greenland flounder.
58.	stellatus,	Stellated flounder.
59.	glacialis,	Arctic flounder.
60.	Labrus suillus,	Norwegian labrus.
61.	exoletus,	Antique labrus, (Fabricius.)
62.	Perca fluviatilis, vel Hudsonia,	Hudsonian perch.
63.	Norvegica,	Norwegian perch.
64.	Scomber scomber,	Common mackrel.
65.	Gasterosteus aculeatus,	Three-spined stickleback.
66.	Canadensis,	Canada stickleback.
67.	Mullus barbatus,	Red surmullet, (Scoresby.)

68.	Salmo salar,	Common salmon.
69.	trutta,	Sea trout.
70.	fario,	Common trout.
71.	alpinus,	Gilt char.
72.	lacustris,	Lake salmon.
73.	stagnalis,	Pool salmon.
74.	rivalis,	Rivulet salmon.
75.	arcticus,	Arctic salmon.
76.	Groenlandicus,	Capelan, or Greenland salmon.
77.	thymallus,	Grayling.
78.	lavaretus,	Gwiniad.
79.	Hearnii,	Coppermine River salmon, (Richardson.)
80.	Mackenzii,	Mackenzie's salmon, (Ditto.)
81.	Nelma,	Nelma salmon.
82.	Kundsca,	Kundscha salmon.
83.	Taimen,	Taimen salmon.
84.	Artedi,	Artedis, or herring salmon.
85.	signifer,	Bach's grayling, (Richardson.)
86.	thymalloides,	Winter River grayling, (Ditto.)
87.	quadrilateralis,	Sea gwiniad, (Ditto.)
88.	carpio,	Carp trout.
89.	autumnalis,	Autumnal salmon.
90.	nasus,	Snouted salmon.
91.	peled,	Peled salmon.
92.	Hiodon clodialis,	Golden eye, (Richardson.)
93.	Esox lucius,	Common Pike.
94.	Clupea harengus,	Common herring.
95.	encrasicolus,	Anchovy, (Fabricius.)
96.	sprattus,	Sprat.
97.	Cyprinus Hudsonius,	Hudsonian sucker.
98.	Forsterianus,	Forster's sucker.
99.	Le Seurii,	Le Seur's sucker.
100.	aphya,	Aphya carp.

To render this general zoological view more complete, we may add a list of the *genera* of other animals, observed in Greenland by Fabricius.

AMPHIBIA.

Rana Temporaria. Frog.

INSECTA.

Cistela stoica.
Selpha pedicularia.
Coccinella trifasciata.
Altica, 2 species.
Curculio, 2 species.
Dytiscus marginalis.
Tenebrio fossor.
Staphylinus, 3 species.
Papilio tullia.
Phalæna, 8 species.
Libellula virgo.
Phryganea rhombisea.
Ichneumon moderator.
Apis alpina.
Tipula, 5 species.
Musca, 5 species.
Voluocella, 4 species.
Tabanus Groenlandicus.
Culex, 3 species.
Empis borealis.
Podura, 6 species.
Termes divinatorium.
Pediculus, 11 species.
Pulex irritans.
Acarus, 9 species.
Phalangium opilio.
Aranea, 6 species.
Pycnogonum, 3 species.
Cancer, 12 species.
Squilla lobata.
Oniscus, 12 species.
Daphne pulex.
Binoculus piscinus.
Cyclops brevicornis.

VERMES.

Gordius, 7 species.
Ascaris, 10 species.
Lumbricus, 11 species.
Amphitrite, 4 species.
Nereis, 17 species.
Aphrodita, 5 species.
Nais, 2 species.
Taenia, 6 species.
Hirudo, 2 species.
Planaria, 9 species.
Fasciola, 3 species.
Mammaria globulus.
Ascidia, 8 species.
Clio retusa.
Lernæa, 7 species.
Lucernaria, 2 species.
Trochus, 4 species.
Turbo, 2 species.
Tritonium, 10 species.
Myxine glutinosa, (a fish, not a worm.)
Doris, 3 species.
Hydra, 2 species.
Actinia, 4 species.
Holothuria, 7 species.
Sepia, 2 species.
Beroe, 4 species.
Medusa, 6 species.
Asterias, 6 species.
Echinus saxatilis.
Sabella lumbricalis.
Serpula, 11 species.
Patella, 3 species.
Argonauta Arctica.
Helix, 3 species.
Pholas teredo.
Isis hippuris.
Tubipora, 4 species.
Nerita, 2 species.
Mya, 4 species.
Cardium, 2 species.
Venus, 3 species.
Arca minuta.
Pecten Islandicus.
Mytilus, 3 species.
Chiton, 3 species.
Lepas, 3 species.
Madrepora, 3 species.
Millepora, 4 species.
Cellipora, 6 species.
Flustra, 4 species.
Tubularia, 2 species.
Fistulana, 2 species.
Sertularia, 9 species.
Alcyonium, 4 species.
Spongia, 3 species.

On reviewing these lists, we find a considerable diminution of the species in the first class of animals, even in the extensive scope which we have assigned to the northern regions. In proceeding northward, we find the resident land mammalia reduced, between the parallels of 70° and 80°, to the polar bear, the wolf, the fox, the Arctic hare, and a species of mouse; though these inhospitable regions are visited by the musk ox, the rein-deer, and, perhaps, some other quadrupeds, in their short summer. Many of the mammalia, however, which inhabit the sea, as whales, the narwal, the walrus, and seals, are found in the highest latitudes to which we have been able to penetrate. Birds, more fitted by nature for extensive and rapid emigrations, are found in high latitudes in greater numbers. Aquatic birds extend to the confines of the impenetrable icy barrier; and the ptarmigan, some of the finches, and, above all, the snow-bunting, appear to be only limited in their ranges northward by the total failure of the berries of the *Empetrum nigrum*, and seeds of the *Betula nana*, on which they feed. Several birds of prey, such as the raven, the Greenland variety of the penguin, the falcon, and some others, roam to the highest latitudes which man has reached.

Fishes, whose element is more liable to be rendered uninhabitable, by the long continuance of its icy covering, are found in smaller proportion. The Greenland seas, and the waters of the north part of America, and of the old continent, are remarkably barren of fishes, with the exception of some species of salmon and herring. The true amphibia are still more rare, and seem to disappear long before any other class of animals.

The severity of an Arctic climate, at first sight, does not seem well suited to any of the insect tribe; but the tormenting clouds of mosquitoes, and sand flies, encountered by Acerbi, Clarke, Scoresby, and Franklin, in high latitudes, show that some species of insects can brave the rigours of an Arctic winter, and require but an ephemeral increase of temperature to call them into an active existence, no less troublesome to man than in tropical regions. The marine insects and crustacea are, however, numerous; and the vermes, and minute animals of the ocean, swarm in countless myriads, and in great variety of form, to the very verge of animated nature; where a barrier of solid ice has hitherto restrained the curiosity and enterprize of man.

Notwithstanding the small variety of animals of the higher orders, the number is, in certain places, and at particular seasons, prodigious. Thus the sea about the coasts is often almost covered with little auks, (*Alca arctica;*) and the rocks on the shores of Greenland and Spitsbergen swarm with ducks, (*Anas mollissima*) and some other species of birds are also numerous. Yet these are but occasional visitors. They retire to these remote regions, where the sea, as soon as the ice makes an opening, is found to swarm with insects suitable for their food, and the rocks afford them congenial places, receiving an astonishing heat from the sun, for the purpose of incubation.

The birds take their departure from Spitzbergen generally in September or October, from the east coast of Greenland somewhat earlier, and from Melville Island about the middle of October. At the time of Captain Parry's wintering, all the quadrupeds, excepting wolves and foxes, had retired to the southward before the end of the same month. The birds returned in the beginning of June, and hares, rein-deer, &c. a little before the middle of the month.

Nature, which has so universally fitted the animal creation for their various circumstances, has, in the case of the Arctic animals, given them a power of resisting the severities of the climate beyond what either occurs in, or is needed by, the species of warmer countries. Thus the birds are clothed so thickly with feathers that, in some of the larger species, they are impenetrable to small shot from a fowling-piece, if received in front; and to this warm coating is added a thick bed of down beneath the feathers. The quadrupeds have also their defence. The bear, besides his thick warm fur, has a layer of fat spread over the whole of his body, which, from its bad conducting power of heat, is a powerful defence against the cold. The seals and walruses have also a similar protection; and all the whale tribe have a still more abundant superstratum of fat, which enables them, while living in an element at the freezing temperature, to preserve in their bodies a uniform warmth, equal to 100° of Fahrenheit's scale.

All the quadrupeds that remain throughout the winter in these regions, probably, are subject either to hybernation, or to what has been denominated a state of *quiescence**, during the absence of the sun. Though an occasional bear is known to stroll from his den in the winter, the species in general, like the brown bear, remain in a quiescent state.

What may be the state of the cetaceous animals in the winter season, that remain in this region, is not known. In the case of a party that wintered in Jan Mayen, in the year 1633-4, it was observed, that the *B. mysticetus* began to appear about the coasts in March. Some persons are of opinion that these also hybernate, lying in a state of repose beneath the ice, for considerable intervals together.

These animals, of which we have hitherto merely spoken *en passant*, deserve more particular consideration. One species, the *mysticetus*, is the principal object of British commerce within the Arctic regions; in the fishery of which we now annually employ 140 or 150 ships, averaging upwards of 300 tons burden. The annual produce of this fishery may, on an average of ten years, ending with 1823, be stated at 1200 whales, producing 13,500 tons of oil, and 6750 tons of whalebone, of the mean value of £400,000, or half a million sterling. The importance of this produce consists in the circumstance, that it is all derived from the sea without any *first cost* or expenses (a small proportion in hemp, &c. excepted) but such as are laid out on articles of British growth and fabrication. Hence the whole annual income from the fishery may be considered as a clear accession to the wealth of the nation. And, in addition to this consideration, the trade employs a number of persons of various occupations, and trains up a large number of hardy seamen, to the great benefit of our commerce in peace, and applicable to the defence of our country in time of war.

But as this interesting branch of our commerce is discussed and described in our article Whale-Fishery, and as the object of the fishery, the capture of the *Balæna mysticetus*, or Greenland whale, is also described under our article Cetology, it becomes unnecessary to enlarge on these subjects in this place.

Sect. VIII.—*Inhabitants.*

Inhabitants.

The pliancy of the human frame to circumstances of climate and quality of food, is greater, perhaps, than that of any other of the animal creation. While the animal kingdom, in general, is distributed according to climate, and particular genera restricted to certain temperatures or localities, removed from which many of them would perish, the human race possesses such superior pliancy as to be able to exist in all climates, from the severe frosts of the Arctic regions to the high temperature of the torrid zone. And an almost equal capability of conforming to peculiar qualities of food, is also possessed by the race of man. While, on the one hand, some animals feed entirely on vegetable, or solely on animal food; on the other hand, our species can subsist not only on the greatest variety of animal and vegetable substances, or on an admixture of both, which is the most usual nourishment; but it is capable of living entirely upon vegetable products, or solely upon animal food; and under each circumstance of attaining almost an equal degree of hardihood and muscular power. Thus we find the Irish peasant, who often subsists almost entirely on potatoes, and the Highlander, whose food is almost confined to oatmeal and barley, equally hardy and muscular, and perhaps more so, than the English peasant or manufacturer, who believes he could not exist without a large share of animal food.

Where the food is confined to the produce of one of the two kingdoms from which our aliment is derived, we find the vegetable kingdom most generally to afford the necessary supplies in almost all countries situated in warm or temperate climates. But the peculiarity, as respects an entire subsistence on animal food, is perhaps confined to the Arctic portions of the globe.

The inhabitants of the Arctic regions are not numerous. They, however, consist of various nations, among which there is a considerable dissimilarity of habits and pursuits. We shall conclude this article by a few observations on these people; commencing with—

Arctic inhabitants of Europe.

I. *The Arctic Inhabitants of Europe.* The origin of the present race of Europeans may undoubtedly be traced to the central regions of Asia. Tradition, philology †, history, and revelation, all combine in showing that country to have been the cradle of the human race, though the periods of the emigrations are veiled in the deepest obscurity. The earliest inhabitants of Europe would appear to have been tribes of Celtæ and Finni. The former appear at a very remote period to have penetrated to the west of Europe; and, at the dawn of history, we find them in possession of Gaul and Britain; and the Finni occupying countries far to the north of the Euxine. From these possessions the latter appear to have been forced by the subsequent irruptions of the Sauromatæ and Teutones.

The Sauromatæ, or Sclavi, seem to have been tribes from Media, or northern Persia, who passed either by the defiles of the Caucasus, or by coasting the shores of the Caspian, and established themselves on the banks of the Tanais. For some centuries they appear to have remained on the northern shores of the Euxine. Impelled by other roving tribes, they took possession of the Carpathian mountains; and, extending themselves over the woods and marshes of Sarmatia, became the ancestors of the present race of Poles and Russians, Vands and Bohemians. By them the Finni were forced northward, and were thus the earliest inhabitants of the Scandinavian peninsula, the shores of the White Sea, and the northern coasts of the Russian empire.

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* Dr. Fleming's *Philosophy of Zoology*, vol. ii. p. 80.

† See Dr. Murray's able work on the *Origin of European Languages.*

The Teutones, another Asiatic tribe, the affinity of whose language with the Persic and Sanscrit has been proved by Dr. A. Murray, seem to have advanced from about the Lake of Aral, and passed directly westward, through the hostile tribes of Sauromatæ and Celtæ; and, long before the Romans had subjugated Italy, the Teutones had established themselves on the Rhine, and sought the alliance of the Celtic inhabitants of Gaul.

About 300 years before Christ, the Teutones had expelled the Finni from the greatest part of Scandinavia. The descendants of these conquerors formed the Gothic tribes, who burst with irresistible fury on the Roman empire, and finally extinguished it in the west of Europe. The Norwegians, Danes, and Swedes, are the descendants of the Scandinavian Teutones, and speak kindred dialects of that extensive language, which was carried into Iceland about the year 874, and about a century afterwards even into Greenland. From these extreme limits, traces of this tongue may be found even to the confines of China.*

The Finni were not exterminated by the Teutones. Many of them were found intermixed with the German colonists in the reign of Justinian I.; and they always occupied the northern parts of Scandinavia, and the shores of the White Sea; where one of their tribes, the Piarmi, or Biarmi, attained to considerable wealth and civilization. The modern people of Finland seem to be their descendants. Permia, according to Torfæus, was invaded by two captains of Hacon, king of Norway, in 1224. They are stated to have conquered the country, after making terrible slaughter of its Pagan inhabitants. The Laplanders are said to have a common origin with the Finns, but are very different in point of civilization. The former are a race of industrious agriculturists; the latter of indolent *nomadic* tribes, who depend for subsistence on a precarious supply of fish from their rivers, and the produce of their flocks of rein deer. In them, the marks of their race are therefore most distinct. They are of short stature, with black, coarse, straight hair, eyes transversely narrow, with black irides; large heads, and high cheek bones. Yet Von Buch assures us, that some of them have true *Turkish* physiognomies. Their language has considerable affinity to the Turkish †, and differs more from the dialect of Finnish spoken at Abo than the Swedish does from the German ‡. The language of the Finns is that of many small Russian tribes, such as the Madernes, the Tschermissi, Syriænes, and Votiacks; and may be traced from the shores of the Frozen Ocean to the range of Caucasus, and the banks of the river Anabara, in longitude 110° east.

Along the northern coasts of Europe, from the eastern shores of the White Sea to the longitude of the Ural Mountains, we find a scattered race, known by the name of Samoides. They are a more barbarous people than the Laplanders; yet their manners and language show them to be of Finnish extraction. They use the rein deer to draw their sledges; but do not milk them. They feed on all kinds of quadrupeds, and on fish. Their manners are brutal and filthy; being far beneath the Laplander in the arts of life. They became subject to Russia about 1525. The Samoides are not confined to Europe, but are also spread over a wide extent of the shores of the north of Asia.

Asiatic arctic tribes.

II. *Asiatic Arctic Tribes.* The Samoides must be a pretty numerous race; for they are found in this quarter of the globe as low as latitude 65°, dispersed among other tribes; and swarm in the vast promontory between the Yenissey and the Anabara, which stretches up to lat. 75°. They are even found dispersed beyond this river, almost to the Lower Lena. The Asiatic Samoides were not conquered by Russia until about a century after their European brethren. The following petty tribes belong to the same stock.

The *Kobiats*, on the Yenissey;

The *Loyotes*, and *Mutores*, on the Sayane Mountains.

The *Tubinzes*, on the left bank of the Yenissey.

The *Kamatschintzes*, around the sources of the rivers Kana and Mana.

The *Yurates*, or *Yurikes*, between the Oby and Yenissey.

The *Karagasses*, in the Udinskoy circle §.

The Samoides call themselves only *Nenetsch*, people, or *Chasovo*, men. The origin of their usual appellation is unknown.

Somewhat to the south of the Samoides, we find the Ostiaks; who, though not numerous, are composed of two distinct people. The Ostiaks of the Narym, or Morases, who occupy the district between the Oby and Narym, the Ket, and the Tom. These appear to be of Finnish extraction; but the Ostiaks of the Yenissey are said to speak a different language from any other tribe in Siberia. This last people are nomadic, dwell on the Lower Yenissey, intermingled with Samoides, and are not numerous.

To the eastward of the tribes already mentioned are found the Yakuts, a people of Mongolian descent, who were driven by the southern Monguls and Buræts to the inhospitable regions of the north; and are now found in the government of Irkutsk, along the Lena, quite to the Frozen Ocean. They are a superior race to those Asiatics already enumerated. They speak a dialect of the tongue of the Monguls, and have their physiognomy. They have a short stature, flat visage, small oblique eyes, thick lips, a swarthy skin, and scanty beard. When conquered by the Russians in 1620, they mustered 40,000 fighting men, and have since increased.

Of the same Mongolian stock are the Tungusi, who have the religion, language, and manners of the Mandshurs. These two nations, with their brethren the Monguls of central Asia, are the descendants of the people who, under the denomination of Tartars, have at different times spread desolation over the fairest kingdoms of Asia, from the confines of Europe to the extremities of China, and the plains of India.

The Tungusi are a numerous but widely scattered nomadic people, who reach from the Yenissey on the west, to the river Amûr and the Eastern Ocean; and are found from lat. 53° to 65°, and even to the borders of the Icy Sea. They are called Lamûts on the Eastern Ocean; but their own appellation is *Œvœs*, or *men*. They made a brave and long resistance to the Russians, and were but imperfectly subdued about 1650. Their wandering life renders it impossible to ascertain their real numbers; but, in 1766, 12,000 males were computed among those most easily reached; a number probably far below the male population of the different tribes. Of all the Asiatic inhabitants of the Arctic regions, the Tungusi are the most civilized; and they have freely admitted various tribes of Samoides, Ostiaks, and Yakuts, to inhabit their wide domains.

The Yukaghires occupy parts of the territory north of the Yakuts, on the Frozen Ocean, from the Yana to the Kovima, or Kolvma. They too are of Mongolian descent, but are ruder than their southern brethren. When they submitted to Russia in 1639, they had not seen horses; although those animals were, at that time, well known to the Yakuts.

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* The people of this race are distinguished by large limbs, fair complexions, and flaxen hair.

† Murray. ‡ Von Buch's *Travels*, p. 245. § Tooke's *View of the Russian Empire*.

The Koriaks inhabit the country west and north of Kamtschatka. They are divided into two nations, the wandering and fixed Koriaks. The first occupy the tract bounded on the east by the Sea of Penschinsk, on the south by the Slanovi Mountains, on the west by the river Kovima, and on the north by the Anadir, and the Anughi. They are a fierce and cruel people, who wander with their herds of rein-deer, but never approach the sea, nor use fish as food. Their persons are lean and short, their eyes, as well as their heads, small, their mouths large, their hair black, their beards pointed, and often eradicated. Their dress is squalid. They are much dreaded by the fixed Koriaks, who inhabit the northern part of the Kamtschatskan peninsula. These last have a few rein-deer, which they use for sledges, but never for their milk. They are a mild and timid race; yet speak a dialect of the same language as their ferocious brethren. This branch of the Koriaks are also called Techuki. They dwell in rude fixed tents, which, like their dress, are of deer skins; their manners are filthy and disgusting; their features are coarse; but they have not the flat visage, and little eyes, of the Mongolian race. The two tribes of Koriaks together are rated at not more than 3000 families.

The Kamtschatkadales are evidently of Chinese or Mongolian descent, as is indicated by their swarthy complexion, broad flat faces, small oblique eyes, slender eyebrows, and scanty beards. The Kamtschatkadales have pendulous bellies, and slender limbs. They are not numerous, only 3000 paying tribute to Russia, including the inhabitants of the Kurile Isles. In 1717, the whole peninsula submitted to Russia. This mountainous and sterile desert is the seat of volcanic fires of great activity; yet it has, on account of the value of the trade in the fur of the sea otter, and for the excellence of its harbour, been colonized by Russia.

The last of the Asiatic nations we shall mention, are the Tschutski, a brave and fine race of men, occupying the vast peninsular extremity of north-eastern Asia. In person, the Tschutski are tall and stout, with long faces, an agreeable physiognomy, and are considerably more civilized than their neighbours. Some of them wear ear-rings, but do not pierce their noses like some other rude tribes. Their dwellings are suited to their boisterous climate and a country destitute of forests, being principally subterraneous. Their dress consists of a jacket, trowsers, and half boots, of neatly dressed leather: and for prosecuting their fishery, which is an important concern, they have water-proof dresses made of the intestine of the whale. They have rein-deer, but use them neither for draught nor for their milk: they employ dogs in their sledges. Their weapons are neatly made bows and arrows, usually carried in an ornamented quiver. They always carry long spears; and are so attached to their arms, that they will not sell them on any terms.

These people have high notions of liberty; and have hitherto resisted all attempts of the Russians to subjugate their country; yet they were courteous and hospitable to Cooke, whose manners so pleased them, that in the next season they offered tribute to the Russians, whom they supposed to be his countrymen.

Several of the islands, which lie between the northern parts of Asia and America, were inhabited by colonists from Asia, when discovered by the Russians. The Kurile islands are peopled from Kamtschatka; the Aleutian isles by Koriaks.

American arctic tribes.

III. *The American Inhabitants of the Arctic Regions* are still more imperfectly known than those of Asia: but, as far as native tradition and recent philological discoveries have thrown light on the subject, there can be little doubt that the American Indians of those regions have passed from the north-eastern extremity of Asia into the new world. The Tchutski twice annually witness the migration of innumerable rein-deer on the ice, to the American continent; and the narrow strait of Behring, rendered more easily passable by the intervention of many islands, which afford food to the deer, would but present a slight obstacle to the enterprize of a nation of hunters. On this subject, however, we can only offer conjectures; and we shall proceed to notice the various tribes met with in the frigid regions of America.

Of all the tribes of the north who retain such a similarity of manners that characterizes them at once as the same people, the Esquimaux is the most extensively distributed. Our most particular acquaintance with this people, is derived from our intercourse with, and from the residence of the missionaries among, the Greenlanders. But people of almost precisely the same character and habits occupy the shores of Labrador, some of the coasts of Hudson's Bay; parts of the northern face of north America, various portions of the north-west coast of the same continent, and some of the islands on the north-east of the Tschutski Noss. They are found as low down on the western shores of America as Prince William's Sound, and Unalashka, between Lat. 54° and 60°. They occur also about Norton Sound, in Lat. 64°, and have been again found on Mackenzie's River, in the Icy Sea, in Long. 128° W., and on Copper Mine River in Long. 116° W. Traces of them were discovered by Captain Parry, on Melville Island, in Long. 110° W. Lat. 75° N. as well as on other islands in the Icy Ocean.

The persons and manners of this widely-extended race preserve a considerable similarity, even in their most remote settlements. They are all addicted to fishing, and the use of a long and slender canoe, of peculiar construction. They occupy subterranean dwellings, and bury their dead under barrows, like the natives of the north of Europe and Asia. In winter, some tribes form houses of frozen snow, which Captain Franklin describes, in his very perilous and fatiguing expedition to Copper Mine River, (p. 265.) as very comfortable. Their language seems to have much uniformity, or to differ less than might have been expected from their widely-scattered situation. This unfortunate race have been persecuted by all their neighbours. The Scandinavian colonists of Greenland dread and hate the Skrllings, (so called from their low stature,) whom their fears or hatred have falsely transformed into cannibals; and the most deadly enmity subsists between the Esquimaux and all the tribes of American Indians. Yet, when well treated, the Esquimaux appear a kind and well-disposed people; but a long series of oppression and treachery has rendered them suspicious, and probably vindictive. Of their descent, we cannot speak with confidence; but their form and features, as well as their manners, approximate to some of the north-eastern tribes of Asia.

These people being more peculiarly Arctic than almost any other, we shall enter into a more particular consideration of their appearance and habits.

The Esquimaux, like the Arctic inhabitants in general, are of a low stature; few of them exceeding the height of five feet. Their face is commonly broad and flat, with high cheek bones. John Sacheuse, who was well known as the Esquimaux who accompanied Captain Ross in his voyage of discovery into Baffin's Bay, and was the interpreter betwixt Captain Ross and the tribe of Esquimaux that he discovered, and named Arctic Highlanders, seemed to be a good specimen of the nation to which he belonged, both as to his personal appearance, and as to his natural faculties. On questioning him respecting the appearance of the Arctic Highlanders, we were much amused with one article of his description. He stated, in pretty intelligible language, that these people were in general very like his own countrymen; but, pointing to his cheeks with both hands, he observed, "they are a great deal bigger here;" intimating, that they were much broader in the face, whereas he certainly was one of the widest faced men we have almost ever seen!

The hands and feet of the Esquimaux are small; their heads large; their hair is coal-black, straight, and coarse; they seldom have any beard, because the little which nature gives them they constantly root out; their clothes are composed of the skins of rein-deer, seals, and birds. There is little difference in the dress of the two sexes. The hood of the jacket is the only cover for the head. The mothers or nurses of infants have their jacket made so wide between the shoulders, that it will contain the child, which they place in it and carry about with them quite naked. In their winter huts, which are remarkably close and warm, both men and women sit either stark naked, or with only their breeches on, the body being invariably uncovered.

Both the men and women frequently visit the ships employed in the Davis's Strait whale-fishery, where the latter, especially, always pay a respectful and assiduous attention to the *cook*. In cases where the whale-fishers are employed in "making off," (that is, packing the blubber of whales recently caught in their casks,) the Esquimaux anxiously collect the skin of the whale, of which the fishers make no use. This, which they generally eat dried in the sun, they will occasionally feast upon in the state it is in when they receive it. And even their infants, which the women sometimes carry with them on board of the ships, eagerly devour the same; for a piece of skin being put into their hands, on which there is a thin rind of blubber, they suck it with every appearance of a relish and enjoyment. The men, in such cases, appear to be careful, and even jealous of their wives in the presence of Europeans; but their daughters are occasionally offered, by an old female domestic, to the embraces of the whale-fishers, the price of the indulgence being a silk handkerchief, or some other equally useful article.

In winter, the Esquimaux reside in huts partly scooped out of the ground, with the roof only rising two or three feet above the surface. The entrance is by a low subterranean passage or tunnel, four or five yards long, which is the only communication with the open air. As they have no fires, but only lamps trimmed with train oil, and moss for the wick, they have no need of chimneys. Hence the heat arising from their lamp, and from the bodies of the inmates, is in a most effectual manner, economized: but the air is, in consequence, so foul and disagreeable, as to be almost intolerable to a European. In summer, they remove from their huts and dwell in tents, which they remove from place to place, according to the facilities they meet with in pursuing their occupations of hunting and sealing. As they are entirely dependant on the animal creation for their subsistence, they are under the necessity of removing their residences whenever the seals retreat from their vicinity. Their most favourite food is the flesh of the rein-deer: but their chief sustenance is derived from seals. It is the great object of their ambition to excel in seal-catching; and a man's dignity and rank among his comrades is proportionate to his skill in hunting and fishing, which with them is the perfection of talent. Their dexterity in seal-catching is extraordinary, though undertaken in small light canoes, not weighing above 20 or 30 pounds, in which scarcely any European can maintain his balance. But, notwithstanding all their address, the peculiar dangers to which they are exposed are the occasion of frequent accidents. They often venture in a boisterous sea, where to the passing navigator, they have the appearance of a human nautilus.

Those of the Esquimaux who are furnished with guns exhibit great cunning and dexterity in the management of them, especially in shooting seals upon the ice. As the seal, when reposing on the ice, always lies either close to the edge, or with a small hole, adapted for his escape, within a yard or two of him, he can never be caught but with the greatest address. The Esquimaux in the neighbourhood of Disco Island use a white screen attached to a pole, which they thrust before them as they crawl along the ice towards the seal. This affords them shelter; and being nearly of the colour of the snow, deceives even the wary seal, and enables the Esquimaux to get within shot, and to obtain a deliberate aim at his prey. The Esquimaux of Greenland do not seem to have any distinction of rank, with the exception of their *angekoks* or priests, not acknowledging either chiefs, princes, or kings.

Their huts vary in size according to the number of families intended to be accommodated, which is generally two or three, but may be from four to ten. Betwixt each family is sometimes a screen of skins, and a lamp at the division post. (We speak of the huts of the Greenlanders.) On one side are the windows, formed of the peritoneum of whales, or the intestines of other animals, sometimes of talc, and on the opposite side is the bench, extending from one end to the other of the house, and joining the wall. On this bench the inmates sit by day, and sleep by night. Where there are young married people, they commonly sleep under the bench, the unmarried upon it, with the sexes separated to different benches after they attain the age of twelve or thirteen. "Notwithstanding their sleeping so mixed together, and their scanty clothing, no illicit passion is entertained in their houses. The married and unmarried, of both sexes, have a certain reserve towards each other, and a repugnance to every thing that, in their opinion, violates decency." As they have no spare room, a stranger can rarely be accommodated without sleeping among the usual inhabitants.

When a European whom they wish to honour visits them, such as a missionary, the principal man of the house places him beside his wife on the bench, he taking the back of the bench, where the children usually sleep. The wife of the missionary Hans Egede Saabye, from whose journal we have freely borrowed in the preceding page, was reduced to a disagreeable dilemma in being weather-staid in an Esquimaux hut. Not being accustomed to a promiscuous intercourse with naked people, she sat up for three successive nights, with a child upon her lap.

Our limits will not allow us to enter fully into the description of the manners of the Esquimaux. We can only, therefore, briefly name a few particulars. And here, as in most parts of the preceding description, we must be understood as referring principally to the Greenlanders; the habits of most of the other tribes, as regards these subjects, not being sufficiently known to enable us to speak with precision concerning them. In their courtships, decorum requires that a girl should not choose to marry, and that her parents should not give their consent; so that the suitor, aided by some of his friends, carries off the object of his affections by force. Sometimes she has no previous knowledge of her lover's attachment; but, whether or not, she must make all possible resistance. When she arrives at the house of her lover, she sits desponding; with dishevelled hair, and seizes the first opportunity to run away and return home. She is fetched back, and often again runs away. Sometimes she yields in a day or two; at others, if her aversion be real, she continues to run away until her lover gives up the pursuit. Formerly, it was the barbarous practice for the suitor to cut slits in the soles of the feet of the obstinate girl, to prevent her from running away; and before these were healed, he calculated upon overcoming her scruples to the connexion.

It is a principle with them, that the murder of a father must be revenged by his posterity, however remote the interval. When a woman dies in child-birth, the infant is commonly buried alive along with her; a practice which they excuse by representing that they have no one to nurse it, and it must necessarily die.

Old persons are not unfrequently destroyed as witches. This takes place either when such a character is really believed to exist, and to have been the occasion of misfortune to any hunters or fishers; or sometimes from malicious or interested motives, when the person fixed upon has no natural protectors, in children or relations. He or she, in such case, is called out of the house or tent, charged with the crime of being an *Illiseetòk*, and summarily stabbed and cut to pieces. On which each one present eats a piece of the heart of the victim, that the ghost of the murdered person may not return and frighten them!

Both women and men assist in the whale fishery, when they attempt it. The former are the principal rowers. They have large boats for the women; the men's boats or kaijaks being small, and so light as to be easily carried under their arm, or on their head, when on shore or upon the ice.

When they happen to kill a whale, or to find a dead one on the shore, it is an occasion of great rejoicing. They cut it up as it lies; each one slicing such of the fat and flesh, and carrying it away, as he can undertake. When the upper part is all flayed off, they actually dive under water to cut away that which is below the surface. Saabye, who witnessed a circumstance of this kind, observes, that "often one stands on the shoulders of another to keep him under water, as his water-proof cloak would otherwise cause him to rise. When he who is under water can no longer hold his breath, he makes a motion with his body, and the man who stands upon his shoulders leaps off. He now thrusts his knife upwards, and rises with a loud roar, which is caused by the air being so long compressed." *

What we have related of the Esquimaux refers principally to those in their native state. Great improvements in their habits and moral condition, however, have been accomplished by the indefatigable labours of the Moravian missionaries among the Esquimaux of Greenland and Labrador. In Greenland these hardy and excellent people have now laboured for above a century, and for a long period had little encouragement to persevere in a work of such danger and privations, excepting an honest zeal for the propagation of the gospel.†

We shall conclude this part of our article with a few particulars respecting the Esquimaux of the Arctic Highlands, and those on the west side of Baffin's Bay, derived from the visits of the whale-fishers, and which have not heretofore been published.

Some of the Arctic Highlanders were visited by the whale-fishers in 1821, on an island near Cape York. They were generally in the occupation of their summer's residences, to which they had adjourned for the sake of fowling and fishing; but their winter recesses were close at hand. At one time, in the summer, there were forty or fifty sail of whalers near this place, which so alarmed the natives, that they retreated in a great measure into the interior of the country. On the first arrivals, however, when there were only two or three ships, they had more frequent and more easy communication with the people, though they could never, excepting in one instance, prevail upon any of them to visit the ships. Generally speaking, they were extremely shy, and manifested a similarity of habit and disposition with those so well described by Captain Ross.

One of our informants, a chief officer of a whaler, was repeatedly on shore here, and saw much of the inhabitants, while his ship lay for many days beset in the neighbourhood. About fifty huts lay seattered along the beach. Some of these were mere summer tents, covered entirely with skins; others were winter, or permanent residences, built of stone. Of the latter a part was covered with stones, the roof being arched, but the principal part was covered with turf, and supported by bones. They appeared to have little or no wood. The benches in the huts, which, among the Esquimaux in a more southern latitude, are always formed of wood, with a space underneath, were here built up solid of stone, and covered with slabs. Here the bones of whales and the horns of narwals, were substituted for wood in the supports for the roofs, and also in the ribs of the roof. Some of the bones had been cut with some sharp instrument. Their knives, as observed by Captain Ross, were made of native iron. Many of them were composed of various pieces rivetted together.

The women were cautiously kept out of the way of the sailors. Very few were seen by the crews of all the fleet during the whole of their stay. On an occasion, when a party of sailors accidentally met with some women in one of their excursions into the interior, they all screamed and fled; and some of the sailors getting near them, the women turned about, shouted, and spat on them. The sailors were invariably refused admittance into the huts where the women were concealed. The captain of one of the ships made every exertion to prevail upon them to permit him to enter one of the prohibited dwellings, but he could not succeed. A boy, however, who had slipped through the land ice, and got his clothes wet, was admitted without ceremony among the women, who treated him with great kindness. They stripped off his wet clothes, and, while they dried them, covered him with seals' skins.

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* Saabye's *Journal*, p. 192.

† It is not within our plan to enter into the history of these missions; but we can with confidence refer the reader who is desirous of information respecting them, to the interesting (and we had almost said classical) account of Greenland, by Crantz. In this work he will also find the best account of West Greenland extant, excepting the brief account by Sir C. Giesecké, (see our article GREENLAND,) and we doubt not will be well repaid for the time spent in reading the work. To this work also, and to our article GREENLAND, we must refer the reader for an account of the Danish settlements in Greenland which began to be formed soon after the first missionary, Hans Egede, proceeded to the country.

One of the first of the natives that was seen, made his appearance very unexpectedly before one of the captains who was taking a survey of the distant ice from an iceberg. He had a boat hook in his hand, which so attracted the attention of the Esquimaux, perhaps for the value of the iron with which it was armed, that he kneeled down and kissed it, not paying the least regard to him who possessed it. He refused him the boat hook, but gave him a bright button or two, with which he was greatly delighted. In general it was found, that bright buttons were in high estimation among these people; some of the sailors having received a *unicorn's horn* of ivory, seven feet long, for a single metal button.

When the sailors were numerous, it was difficult to get near the natives, as they commonly fled on their first appearance. Sometimes, however, in a wicked frolic, they contrived to surround an unwary Esquimaux, and then suddenly rush upon him, not a little entertained with the grotesque expressions of fear which the helpless creature manifested.

These people understood and entered into some of the frolics of the sailors with peculiar readiness. On one of the Esquimaux attempting to retreat from a party of sailors, pursuing him for the sake of a frolic, the traces of his sledge broke, and his dogs ran off, on which he was speedily overtaken. While he yet remained in great fear and consternation, the sailors came up, mounted him upon the sledge, and immediately, with great good humour, and no little noise, began to drag him forward towards the shore. The Esquimaux instantly entered into the joke, and raising himself on his sledge, expanded his whip, and, after cracking it in the air two or three times, began very frankly and liberally, to the no small mirth and astonishment of the sailors, to exercise it on the backs of his new traineaux.

Pulling noses seemed to be their highest expression of thankfulness or politeness, as it was only practised on particular occasions. One of the captains having decorated a prominent character, with a parcel of ribbons about his head, to crown the princely gift, presented him with a small looking-glass; on which the man was in such raptures that he could not contain himself. He pulled his nose, bowed his head, then pulled his ears, fell on his knees, jumped up, whirled round, and played such a variety of antics, as almost overwhelmed the company in fits of laughter.

They refused all kinds of food presented to them. One of the captains endeavoured to prevail on an Esquimaux to eat a little white biscuit, but, after tasting it, he spat it out. Being rather teased to try it again, and to eat it, he ran to a *store*, and, with a piece of shell, he cut off a slice of the flesh of a seal, that had evidently been long dead, being quite putrid. This he took betwixt his teeth, and cutting one-half of it off, he presented it to the captain, (whilst he ate the other half,) intimating by *signs*, so intelligible that could not be misunderstood, that, if the captain would eat the seal's flesh, he would then in return partake of the biscuit. The challenge was of course declined.

It was observed, respecting these people, that most of them had their nostrils stuffed full of moss.

Their dress was prepared of skins with the hair on, and not of the water-proof kind used by the Esquimaux of Disco Island and the neighbourhood.

These people were of a thievish turn, attempting to steal every thing they could lay their hands on; several of them tried to wrest an oar from one of the sailors. Perhaps this disposition was encouraged by the circumstance of some of the whalers being wrecked in their neighbourhood. On which occasion, having been permitted to carry away almost what they pleased, they might naturally extend the prerogative then given them to other cases. Many of the articles they thus acquired being almost of incalculable value to them, especially wood and iron, they loaded their little sledges in such a way that their dogs could not move them. The conduct of some of them excited attention and even amusement on this distressing occasion: for, it was observed, that when thus circumstanced, the owner of the sledge would sometimes mount upon the top, for the purpose of exercising his whip over the dogs, which, previously to the addition of his weight, were so overloaded as to be incapable of moving.

The Arctic Highlanders do not seem to be acquainted with the canoe used by other Esquimaux. Captain Ross could not ascertain that they knew any thing of a boat; but some of the whalers afterwards met with a very rude vessel of this description, which they employed in securing the narwals, after being attacked and killed from the land-ice. In their capturing of this animal, these people stand in a line along the edge of the land-ice, or by the side of a narrow vein of water in the ice, where the narwals often appear. When one comes sufficiently near, one or more darts are thrown into it, having a line attached made of skin, with a drag at the end. On its reappearance, which is often by the edge of the ice, it is again attacked with darts, &c. and perhaps killed, though it is evident, without the use of boats for the capture, many of the narwals must escape.

In their pursuit of the whales, the British fishers, having recently been in the habit of approaching very near to the western coast of Baffin's Bay, have discovered different tribes of natives. Besides the people visited by Captain Parry, another tribe was met with a little to the southward of Cape Jameson, in the year 1821, on a low flat strand, where a considerable number of persons, chiefly women, were seen. They were seen by several of the whalers. On the landing of one party of sailors, they were received by thirty or forty women on the beach, and welcomed by loud shouts and exclamations. They appeared to be a wandering tribe, their residences being in tents, erected on poles or bones, covered with skins. There were no men among them excepting two or three old persons, and one who was maimed, having lost one of his feet. The rest of the men, it was presumed, were out upon some hunting expedition. They were greatly attracted by bright buttons. Their dress was nearly the same as the Esquimaux of the opposite coast; men and women being habited nearly the same. The women were all disfigured in their faces by a sort of tattooing. One of the sailors entered a tent uninvited, in which was a woman suckling an infant, and an old man. The female was quite naked, excepting a piece of skin about her shoulders. She did not rise from her seat on the entrance of the sailors, nor did she seem much surprised. She nodded to him, however, and repeatedly pronounced the word *timeah* or *tymah*, which he understood as an invitation of welcome. These women were totally free from the reserve, and even from the portion of delicacy, which Egede Saabye states as being common to the females of Greenland. They went voluntarily, and with great freedom, on board of the whalers in their canoes; and such was their insensibility to ordinary decency, that, on the least hint from any of the sailors, they would immediately slip off their dress, and expose themselves in a state of nudity, without any appearance whatever of shame or confusion.

The north American Indians have been successfully classed by the American physiologists into three great nations distinguished by their language.* These tongues are extensively disseminated through that vast continent, and used by people at great distances from each other. They are, 1. The *Floridean*, which is spoken by the Creeks, Chickesaws, Chocktaws, Cherokees, Pascagoulas, and some other southern tribes. 2. The *Iroquois*, spoken by the Mengwe or Six Nations, the Wyandots, the Nadowessees, and Asseeneepoytuck or Stone Indians. 3. The *Lenni-lenape*, spoken by a great family, more widely spread than the other two, from which the Crees, the Chipewyans, the Copper, and the Dog-rib Indians are derived. Into those three families philological investigation has reduced the supposed multitude of North American tongues, and under them may be classed the numerous tribes mentioned by the early French writers, who have involved the subject in inextricable confusion, by neglecting the only true test, similarity of language, and adopting the appellation of every petty tribe, derived from their hunting grounds, as the mark of a different race.

The general tradition of the Lenape is, that their family originally came from the westward, taking possession of the whole country from the Missouri to the sea, and destroying the original inhabitants, whom they name Alligewi. In this migration and contest, which continued for many years, they say that the Iroquois moved in a parallel line with them, but in a more northerly course, and finally settled on the St. Lawrence. The Lenape, being the more numerous family, soon sent detachments northward, as far as the shores of Hudson's Bay, and gave rise to the chief northern tribes now along the Arctic circle. This account gives colour to the tradition of the Chipewyans, who are a numerous tribe of Lenape, that their immediate ancestors were from the *eastward*, contrary to the general tide of migration above detailed. There is high probability in these traditional documents; and if we may be allowed to speculate on the slender data yet before us, the American Indian, of at least the last two families, may be considered as more recently come into America than the Alligewi. If we are to consider the curious antiquities of utensils, metal ornaments, tumuli, barrows, and substructions, recently described at Circleville and elsewhere,† as remains of that people, the Alligewi must have been a race of men considerably advanced in refinement, until they were dispersed or exterminated by clouds of ferocious hunters advancing from the west.

The North American Indians have many things in common with the nomade and hunter tribes of eastern Asia. Those of the Five Nations have a strong personal resemblance to the Tschutski, who appear to be of Tatar descent from the fine race of Kabardinski. Scalping their enemies, eating human flesh, tattooing their skins, clothing themselves with skins of wild beasts to get near their prey, (as is practised by the natives of Nootka Sound,) have strong resemblances to what has been detailed of the customs of some tribes of ancient Scythæ; and the latter circumstance may be the origin of the fabled annual transformation of one Scythian horde into wolves.

The restless spirit which has so often made the Mongul Tatars the scourge of the civilized world, may be supposed to have occasioned migrations from Asia to America, by the narrow strait of Behring, and the numerous islands between that passage and the promontory of Alaska, without violating any historical probability; and it is not unlikely that the philological researches which have been so successfully prosecuted of late years, will lead to the discovery of affinities between the languages of eastern Asia and America. The Indian tribes who inhabit the north-western part of America are but little known to Europeans. On both banks of Mackenzie's river are the Squint-eyes, or Quarrellers, or Loucheux. This tribe speak a dialect of the Esquimaux, with whom they mingle at the mouth of that river. With this tribe Russian copper coins have been found. These people trade with Fort Good-Hope, the most northern settlement of the North-West Company, on the confluence of the Great Bear Lake River and Mackenzie's River. On the north side of Great Bear Lake are found the Hare Indians,—a tribe of the Lenape, or Chipewyan family, who are among the most civilized Indian tribes in this quarter, and are reckoned by the Dog Ribs and Chipewyans great conjurors.

The Nath-Ana Indians, the Sheep Indians, the Rocky Mountain Indians, the Strongbow Indians, the Beaver and Thick Wood Indians, are all tribes of the great Chipewyan family. The Strongbows are a haughty but friendly tribe, and are esteemed excellent hunters. Both they and the Rocky Mountain Indians believe that they came originally from the west from a level country, where there was no winter, which produced trees and large fruits now unknown to them; and "it was inhabited by many strange animals, amongst which there was a small one, whose visage bore a striking resemblance to the human countenance;" and their tradition is, that their ancestors were forced to leave their native seats by *the rising of the waters*. Then they migrated *northward*, following the tracks of animals along the sea-shore, until they came to a narrow strait, which they crossed on a raft; but the sea having afterwards been there frozen, they were unable to return. This tradition seems to imply an Asiatic migration. These tribes dwell on the western banks of Mackenzie's river.

Of all the Lenape, the Dog-rib Indians seem to be the most civilized, if we take their treatment of their women as a criterion. The drudgery of the tribe is not, as in other Indian nations, performed by the women, but by the men. The women perform only the lighter kinds of employment, as making garments, and embroidering their ornaments; and a new married Dog-rib Indian takes a pride in displaying such proofs of the skill of his wife. The Dog-ribs are fond of dancing and singing; their temper is mild, cheerful, and hospitable; their habits somewhat indolent. Their traditions derive them from the westward. They inhabit the country between the Copper-mine and Mackenzie's Rivers. They speak a dialect of the Chipewyan. The Copper Indians are essentially of the same race; but differ from the Dog-ribs in their treatment of the women, and are contented to borrow the dances and rude songs of the latter. The Copper-mine Indians often have warred with the Esquimaux, with whom they were, until Franklin's journey, at deadly enmity. They are a shrewd people; and since they have procured fire arms from the traders, have commanded the respect of the Chipewyans, who formerly tyrannized over them. They wholly subsist, like the other American Indians, by hunting or fishing, and obtain supplies of arms, ammunition, ornaments, and unfortunately spirituous liquors from the fur traders, in exchange for the skins of beavers, and other objects of the chase. The men affect to treat their women with contempt, yet are on the whole less supercilious than many of their brethren; and Franklin has seen them evince much natural affection. They are decidedly superior in moral qualities to their neighbours the Chipewyans; and though covetous, and little scrupulous in evading promised favours, they evinced kindly affections, and even delicate attentions to the distressed state of Franklin and his party, in their disastrous expedition between Fort Enterprise and the Icy Sea. Among them, as with the northern Indians in general, polygamy is rare except with the chiefs. They may marry two sisters; but a man cannot take his niece to wife. The whole of the Copper Indians do not exceed 190 individuals; of whom, about 40 males, with a proportionate number of females, are under the authority of their principal chief Akaitcho, or Big-foot. The Chipewyans, who inhabit the country between the great Slave Lake and Lake la Crosse, may be considered as the representatives of the family. Their manners have been considerably altered, and their character deteriorated, by their communication with the Europeans and Canadian fur hunters; but they have preserved a much greater share of independence and originality of character than their kindred the Crees, who inhabit the territory about Lake Winnipeg, and the nearest settlements of the Hudson Bay Company. The Crees, by the habitual use of rum, are debased into a haggard and squalid race, negligent of every thing but the means of intoxication, with manners dissolute and disgusting. Their women have intermarried with the voyagers; and the mixed race are generally abandoned by their white parents to all the vices and misery of a life composed of the worst traits of the savage and civilized state. Franklin excepts from this heavy censure the *Orkney men*, who have, in great numbers, entered the service of the Hudson's Bay Company, and who have generally taken care of their offspring by Cree women.

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* Heckewelder's Essay, *Amer. Phil. Soc. Trans.*

† *Amer. Phil. Trans.*

To the south and westward of the Crees, in the neighbourhood of Carlton-house factory, reside the Asseenaboine, Eascab, or Stone Indians, a tribe of the Iroquois family. They are a handsome race, with high features, and well-made forms; but they are represented as treacherous and cruel; and, being mounted on horseback, are formidable enemies. They live at amity with the Crees, under whose protection they entered their present territory; but they are more numerous than their allies. These two nations are in the habit of uniting in annual predatory incursions into the territories of the Indians to the westward, whom they stigmatize by the name of *Slave Indians*, or rather *Strangers*. In these equestrian expeditions both tribes often collect 300 or 400 horsemen, display the cunning and secrecy of Indian warfare, and usually commit the most horrible atrocities on their opponents, sparing neither age nor sex, and carrying off the scalps, which they attach to their dress as proofs of their prowess. The tribes driven westward by these marauders, have settled at the foot of the Rocky Mountains near Fort Augustus, where they have latterly increased in numbers; and having dedicated themselves to the breeding of horses, and acquired the use of fire arms, they already have become objects of terror to the Stone Indians. They are divided into five nations: 1st, The Fall Indians, who formerly resided on the falls of the Saskatchawan River; and are the Minetarraes with whom Lewis and Clarke had a rencountre on their return from the Missouri: 2d, The Pegans, or Muddy-river-Indians, who have 400 tents; 3d, The Blood Indians, who have 300 tents; 4th, The Black-foot Indians, who have 350 tents; 5th, The Sassees, or Circees, who have 150 tents. The language of the first tribe is very guttural and difficult; that of the Pegans, Blood, and Black-foot Indians, is said to be soft, and easily acquired, but to be quite distinct from the Chipewyan; that of the fifth is a dialect of the Chipewyan, which is also spoken by their neighbours the Saow Indians, and by the Nohhannies and Brush-wood Indians of the Rivière aux Liards.

The customs of all the Indian tribes have much similarity when unadulterated by European communication. They are all hunters, who display much address in procuring game; they inhabit tents of skins, or huts composed of boughs of trees, plastered with mud. Their notions of religion are very rude and simple. They generally acknowledge a great supreme Spirit, the author of good; and also worship a genius of evil to deprecate his wrath. The religious rites of the Crees, and other Chipewyans, consist of offerings of various articles to their deity; in prayers for success in hunting, and other necessary avocations, in which they remind the object of their worship of the value of their offerings. The use of tobacco, and the Calumet, or pipe of peace, is generally diffused among them. In manners and mental qualities the Lenape family seem to have the advantage of their neighbours of the Iroquois race. Tribes of them are found in Canada, and in the neighbourhood of Hudson's Bay: they are traced as far as Mackensie's River, Peace River to the south, and even to New Caledonia.

The North American Indians have a considerable resemblance in appearance, though less so than was formerly supposed. They are all swarthy, or of a reddish-brown hue, have dark eyes, and black hair, which is long, lank, and coarse. The features of some of them, especially towards the north, are flat, the cheek-bones high; but some of the tribes have very handsome countenances, Roman noses, and lengthened oval faces. It is to be regretted that, long as they have been known to the European race of men, so little has been done to reclaim them from a savage life, or to humanize their manners by the benevolent precepts of Christianity. Few Europeans have acquired their languages; and unfortunately those who have thus become qualified to be their instructors, have, in general, been more ready, by their example, to teach them the vices than the virtues of civilized life.

Pennant's *Arctic Zoology*. Cook's *Voyages*. Phipp's *Voyage*. Scoresby's *Arctic Regions*. Scoresby's *Journal*. Ross's *Voyage to Baffin's Bay*. Parry's *Voyage to the North West Ocean*. Manby's *Voyage to Greenland*. Franklin's *Journey to the Polar Sea*. Sir A. Mackenzie's *Journies in North America*. Hearne's *Journey*. Sir G. Mackenzie's *Iceland*. Hooker's *Iceland*. Henderson's *Iceland*. Fabricii *Fauna Grœnlandica*. *Flora Lapponica*. Von Buch's *Norway*. Acerbi's *Travels*. Wahlenberg's *Observations, &c.* *Fauna Suesica*. Pallas' *Travels*. Latham's *Ornithology*. Shaw's *General Zoology*. Tooke's *View of the Russian Empire*. Brewster's *Paper in Phil. Trans. Edin. On the Temperature of the Globe*. Lewis and Clarke's *Travels in North America*. Murray's *Origin of European Languages*. *Transactions of American Phil. Society*. *Petersburgh Transactions*. *Linnæan Transactions*. Crantz's *Greenland*. Torfæus, *Hist. Norveg*. Crantz's *Description of Greenland*. Saaby's *Journal*. See also our

articles **Greenland**, **Ice**, **Iceland**, and **Meteorology**.

st Ap-dix.

The return of the Second Expedition, termed the North-West, under Captain Parry, affording us some additional knowledge of the Polar Regions, and much interesting information respecting the Esquimaux of the north-eastern peninsula of America, we shall append to this article some account of the recent voyage. This expedition consisted of two ships, the Fury and Hecla; the latter under the command of Captain Lyon. These ships, accompanied by the Nautilus transport, sailed from the Nore on the 8th of May, 1821.

The first iceberg was seen in latitude, 60° 48′ longitude 53° 13,′ on the 14th of June; and the expedition reached the edge of the packed ice, at the mouth of Hudson's Strait, on the 18th. On the 1st of July, the Nautilus, being cleared of the stores she conveyed for the expedition across the Atlantic, returned to England, having augmented their resources to three years provision, &c. at full allowance.

At their first entrance into Hudson's Strait, they encountered considerable impediments from packed drift ice, so that on the 20th of July, they had penetrated little more than two degrees of longitude beyond Resolution Island, at the entrance of the Strait. At this point the ships were visited by several Esquimaux, whose manners were disgusting in the extreme. The impression made on the mind of Captain Parry, as to their moral condition, was so unfavourable, that he remarks that the nations of this part of Hudson's Strait seem to have acquired, by an annual intercourse with our ships for nearly a hundred years, many of the vices which unhappily attend a first intercourse with the civilized world, without having imbibed any of the virtues or refinements which adorn and render it happy.* A better behaved party, however, of the same nation, visited the expedition on the 31st of July, higher up the Strait.

The greatest obstruction of the navigation of Hudson's Strait from ice, occurs in the first five degrees of longitude, or as far as Savage Island; afterwards, with the exception of a small patch near Charles Island, little or no obstruction is usual. And such was the experience of Captain Parry.

After leaving Hudson's Strait, the expedition proceeded up Fox's Channel, to he eastward of Southampton Island. It came to *new ground* on the 8th of August, near Baffin's Island, which lies on the north-east of Southampton, where the discoveries of Captain Parry may be said to commence.

The interruption from ice now became constant, so that the progress made was often extremely tardy. Their object was to penetrate through Frozen Strait, or the channel on the north of Southampton Island, and to proceed round to the westward into Repulse Bay, to examine whether the American continent did not here terminate. This bay they entered on the 21st of August, and on the day following satisfactorily determined the continuity of the land all round. The account of Repulse Bay, as given by Captain Middleton, was found to be very accurate, with the exception of its geographical position, the fixing of which our early navigators had not the means of accomplishing.

The land to the north and north-east of Repulse Bay was named Melville Peninsula, the coast of which was now examined towards the north. Part of the northern boundary of Frozen Strait was found to consist of islands, betwixt which and the main a small channel was discovered. This afforded them a short but dangerous passage into a sea much encumbered with ice. Having moored to a large piece on the 1st of September, they drifted during a gale from the northward to the very spot, near Southampton Island, where they had been nearly a month before.

On the 5th, having had a clear run to the northward, they came to the entrance of a fine opening into the main land, running towards the north-west, which it now became an object with them to explore. The ships penetrated a few leagues, and the examination was completed in the boats by Captain Parry in person. This inlet, which was named after Captain Lyon, was closely explored to its termination in Ross's Bay, a distance of 50 miles from the ship. In this examination, which occupied seven or eight days, a party of Esquimaux was discovered. Captain Parry, who visited their hut, thought them a good-humoured decent sort of people, not devoid, however, of the propensity to thieving which is too common in people of this class. Among the Esquimaux remains found here was a curious net, formed of rings of whalebone, tied together by fibres of the same.

An interval of land between this place and Hurd's Channel being yet unknown, Captain Parry next employed himself in tracing it in a boat, which occupied him nine days, in consequence of a detention from the ice setting upon the shore. The entire continuity of the land, however, was clearly made out.

In proceeding out of Lyon's Inlet, they encountered a heavy gale of wind, accompanied by all the signs of incipient winter. It commenced on the 30th of September, and continued three days. They fortunately sheltered in a small nook, that was called, in consequence of the retreat it afforded, *Safety Cove*.

By this time they had fairly made their way out of the inlet, the sea became covered with new ice, as well as encumbered by old. Intercepting their progress to the northward was an island lying off the eastern headland of Lyon's Inlet, which it was necessary to double. Before, however, they could accomplish this object, the rapid increase of new ice, (with a fall of the thermometer to zero on the 8th,) put a stop to their progress, and induced them to seek out for winter-quarters. The most suitable situation that offered was a small bay at the southern corner of the contiguous island, (which they named *Winter Island*,) where the ships were hauled inshore, in a place defended by some masses of grounded ice, on the 8th of October. Their position was in latitude 66° 11′ 26″, and longitude 83° 9′ 49″ west, where they remained in security the whole of the winter. This parallel being without the arctic circle, does not properly belong to our article; but the climate being here truly polar, we shall not withhold some remarks respecting it.

On the 21st of October, the thermometer fell to —13°, when the timbers of the ships began to crack, "in consequence," as they considered, "of the freezing of the juices of the wood." The true cause of this phenomenon, however, we conceive to be in the extraordinary dryness of the air at low temperatures. On the 25th the thermometer rose to +25°, when they experienced an *inconvenient* degree of warmth.

An admirable system for economizing heat and warming the ships devise by Mr. Sylvester of London, which contributed vastly to the comfort of our voyagers. By means of a stove that only required a bushel of coal per day, a uniform and comfortable temperature was kept up on the lower deck throughout the winter. During a severe storm, when the abstraction of heat is the greatest, with a temperature 25° below zero, the thermometer on the Fury's lower deck never fell below 56°, and in the "Sick Bay," it was always above 60°.

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* *Journal of a Second Voyage*, p. 15. It will not be necessary to quote this work regularly as we proceed, because we are indebted to it principally for the account of the voyage we here give.

One of their amusements, as on the former voyage, was theatrical representations, to which was added exhibitions of phantasmagoria; and among their more important occupations was the establishment of schools for the sailors, at which about twenty of each ship's company attended every evening, from six to eight o'clock; and the regular and orderly attention to divine service on the Sabbath days. It is worthy of remark, that the idea of the schools originated with the sailors themselves.

Before the ships were permanently frozen in, several black whales came up to blow in the pools left open by cutting the ice.

In the course of the winter, several white foxes were caught in traps, and some of them kept alive on board; and hares and wolves were occasionally seen. As the sea was frequently open at a short distance from the ships, in the winter, seals, walrusses, and some birds, were generally in the neighbourhood. There were myriads of shrimps, (*Cancer nugax*,) near the surface of the sea, which seized on any meat put overboard with such avidity and effect, that they were successfully employed in anatomising various specimens of natural history. This service they accomplished with astonishing rapidity and completeness. A goose that had been put overboard to thaw or soak by the officers of the Hecla, was in 48 hours completely cleared of the meat, leaving only a skeleton most delicately cleaned.

The wolves that came about the ships became annoying, injuring the sails and carrying away the dogs of the Esquimaux.

The state of the atmosphere throughout the winter is worthy of remark. The sky was generally clear. Though it was sometimes overcast or obscured by a slight general haziness, there were no separate *clouds*; a meteor which, indeed, they had not hitherto seen during the winter in these regions. Haloes and auroræ boreales were seen not unfrequently. No effect was observed to take place on the magnetic needle during the appearance of the latter phenomenon; nor any action whatever on an electrometer connected with a wire from an insulated conductor carried above the highest mast.

On the 20th of January, 1822, the greatest cold observed during the winter occurred, the thermometer indicating a temperature of 40°.

The tedium of confinement was vastly relieved, and the excitement so much wanted afforded, by the fortunate arrival of a party of Esquimaux, who, to the amount of above 60 persons, made their appearance near the ships on the 1st of February; or rather were found to have planted themselves there in a village of *snow* huts. These persons, consisting of men, women, and children, afforded an interesting source of amusement, investigation, or occupation, to the officers during the remainder of their detention. Their minds, diverted from mere external inquiries, were naturally directed with a peculiar energy to the investigation of the character and habits of these singular people. The result of these inquiries is given towards the conclusion of Captain Parry's narrative, and will be reserved for the close of ours.

Their habitations consisted of huts, ingeniously but speedily constructed of blocks of snow. The whole material was snow and ice, the roof being supported by its arched structure, having the form of a dome, which was constructed of separate blocks of snow, laid with great regularity and no small art.

A Six's thermometer being sent by a kite to the height of 379 feet perpendicular, gave as the lowest temperature 23¼°, whilst the temperature on the ice was 24½°. This result is very nearly the decline of temperature that was to be expected.

On the 2d of March, the thermometer first rose above zero, since the preceding Christmas.

On the 7th, the produce of ice, during five winter months, in a single level sheet, was found to be 4 feet 7 inches in thickness. The ice was hard, brittle, and transparent, though formed on the sea, except 6 or 8 inches of the lower surface, which was porous.

An excursion over land, to a short distance, which had been for some time meditated, was undertaken by Captain Lyon on the 15th of March. When the party set out the temperature was zero, and the wind moderate; but it soon increased to a hard gale, and the thermometer fell to — 32°. This proved a dangerous exposure, and the most severe that occurred in all their adventures. They returned the following day with great difficulty, and arrived most providentially, in the obscurity of a snow-drift, at the ships, when some of the party were all but exhausted. At this critical time the ship was discovered, and no very bad consequences ensued, though the most fearful consequences were narrowly escaped. One man lost some of the flesh of two of his fingers. Another who had been the most hardy while in the air, fainted twice on going below; and all the party had severe frost-bites in different parts of the body, which recovered after the loss of skin usual in these cases.

Very considerable snow-drifts occurred here in the spring; but not so frequent or so thick as at Melville Island, though the fall of snow was greater. The difference of latitude between this station and Melville Island was 8½ degrees, notwithstanding which the spring was only a fortnight earlier here.

Some hard well-defined clouds appeared on the 16th of April, which were nearly the first that had been seen. The first flock of ducks was seen on the 15th of May. The progress of spring was as follows: Few symptoms of thawing had occurred even to the end of the month of May. The first indication of vegetation, (little more than microscopic,) was discerned on the 31st of May; and the first flower, a specimen of Saxifraga oppositifolia, on the 9th of June. Towards the end of the month, the ice was so far decayed and broken away, that means were taken to effect their liberation.

On the 2d of July, the ships obtained a release from their winter quarters, after near nine months detention; and proceeded, the same day, ten leagues without obstruction to the northward, and entered the *Arctic* Regions. The land from hence tended chiefly to the northward for a considerable distance, along which the expedition proceeded, between the eastern ice and the land, in a difficult and hazardous passage, and meeting with occasional complete stoppages, and some very threatening adventures. On the 13th, they reached Cape Penrhyn, a bold headland in latitude 67° 20′, a situation farther to the northward, in this channel, than any other navigator had penetrated. "Fox's Farthest," the highest point of land discovered by Fox, is probably not quite so far north. After passing Cape Penrhyn, they fell into a clear sea, in which they had a man was 5 ft. 10 in. and the shortest 4 ft. 11 in.; the tallest woman 5 ft. 8½ in. and the shortest 4 ft. 8¾ in.

In their figure they are rather well formed; their hands and feet are small; their faces are round and full, eyes small and black, nose also small, and sunk far in between the cheek bones. Their hair is black and straight; when clean washed, they are not of very dark complexion, and not by any means ill-looking. There were, indeed, three or four grown up persons of each sex, who, when divested of their skin-dresses, their tattooing, and dirt, appeared in the eyes of our voyagers as not only pleasing-looking but handsome. The women pride themselves in the length and thickness of their hair, which they carefully dress and plait into two tails, but think it of no importance to cleanse. Hence "the hair is full of vermin, which they are in the constant habit of picking out and eating; a man and his wife will sit for an hour together performing that friendly office for each other!" When a woman's husband is ill, she wears her hair loose, and if he dies, she cuts it off as a token of mourning. The men wear the beard on the upper lip and chin, from 1 to 1½ inch in length, and some were distinguished by a little tuft between the chin and lower lip.

The dresses of both male and female are composed almost entirely of deer skins. The form of the dress is that commonly worn by the Esquimaux, but probably larger and wider. The jacket of the women has a broad tail behind reaching almost to the ground, and a narrower and shorter point depending in front. In winter they wear, when abroad, two jackets; the inner one with the hair inward, and the outer one with the hair outwards. Their dresses are neatly made and variously ornamented. In winter both sexes also wear two pairs of breeches. Their legs and arms are still more securely defended from the weather. When engaged in sealing excursions the men wear a pair of deer-skin boots, and a pair of shoes, and a pair of water-proof seal-skin boots, and shoes of the same over them, making four coverings for the feet. The exterior boots of the women are preposterously wide on the outer side, so as to give women a most awkward bow-legged appearance. These boots are their principal pockets, and are said to be employed by the native women of Labrador to carry their children in.

A peculiar ornament of these people consists in strings of teeth of the fox, wolf, or musk ox, either attached to the lower part of the jacket, or fastened as a belt round the waist.

All the women were tattooed at an early age. This *ornamenting* of the skin is applied to the faces, arms, hands, thighs, and in some few women, to the breasts, but never to the feet, as in Greenland. It is performed by passing a needle with a thread, covered with lamp-black and oil, under the epidermis.

Their winter habitations, it has been already remarked, are formed of snow and ice, principally snow. The height is usually six or eight feet, and diameter eight to fifteen feet. The blocks of snow, which are taken from a hard compact drift, are about two feet in length, and six or seven inches in thickness. Sometimes two or three other huts are built round the first one as a centre, and all communicating with it, where several families reside together. Each hut is illuminated by a circular plate of ice, three or four inches thick, and two feet in diameter, through which the transmitted light is soft and pleasant, and quite sufficient for every purpose. All round the interior of the apartment is a bank of snow, two and a half feet high, which forms their beds and fire-places. The beds are arranged by first covering the snow with a quantity of small stones, on which are laid their paddles, tent poles, and some blades of whalebone: above these they place a number of pieces of network, made of thin slips of whalebone, and lastly, a quantity of twigs of birch and of the Andromeda tetragma. Their deer skins, which are very numerous, are now spread without risk of touching the snow, and amid them, not merely comfort is obtained, "but luxurious repose, in spite of the rigour of the climate."

The fire belonging to each family consists of a single lamp, or shallow vessel, of lapis ollaris, its form being the lesser segment of a circle. Along the straight edge of these lamps, which in some is eighteen inches in length, is laid a row of fibres or wicks of dry moss, and such portion lighted as is required for the occasion. When the whole length is kindled, it affords a most brilliant and beautiful light, without any perceptible smoke or offensive smell. Along this a slice of blubber being suspended near the flame, supplies the lamp with oil, without the trouble of extracting it. Over these lamps all their cooking operations are performed. They are indeed their only fire.

The snow huts, by this means, being raised to a temperature of between + 20° and + 30°, even in the greatest cold of the winter, become comfortable and healthy habitations; but when the temperature comes to or above the freezing point, the dropping of water becomes inconvenient and injurious, and renders the inmates liable to take cold. They use cooking pots of lapis ollaris; and employ pieces of asbestos for trimming their lamps.

They have knives, which appear to have been indirectly procured from the factories of Hudson's Bay. But some of the old structure, described by Crantz, are of their own manufacture.

For obtaining fire they use iron pyrites, two lumps of which being struck together, give sparks. Those sparks are received among a tinder of well dried moss, with a small quantity of the white floss of the seed of the gummed willow laid above the moss. The spark caught by this tinder is blown, and flame derived from it on the pointed end of a piece of oiled wick.

These people feed upon almost every animal inhabiting the region of their abode. Their principal dependence, however, is on the rein-deer, musk-ox, (where it occurs,) whale, walrus, seal, and salmon. The seal and the walrus are their principal support in winter. Of these there are in general some to be had, but the people are so voracious in their appetites, and so improvident of their supplies, that they often fall short, and suffer dreadful privations. Captain Parry, during his stay here, had occasion repeatedly to relieve their necessities,—a whole tribe being sometimes without a single article of food, or without the means of lighting or warming their miserable dwellings. In such extremity their skins used for clothing are employed to satisfy the cravings of nature.

They prefer their meat cooked; but this is a luxury not necessary to them, as they feed upon it raw and frozen with great relish. They do not eat fat or blubber alone, unless very hungry, and in necessity; they commonly take an equal proportion of lean with it. Oil they do not use as a part of general diet.

They eat enormously, when an opportunity of fully satisfying themselves occurs, and frequently suffer inconvenience, sometimes disease and death, by their intemperance in food. They were occasionally seen by our voyagers indulging in gluttony in its most disgusting form. Many were observed "wallowing in filth, while some, surfeited, lay stretched upon their skins enormously distended, and with their friends employed in rolling them about to assist the operations of oppressed nature." An experiment was made by Captain Parry on a lad, scarcely full grown, to ascertain how much he would, without inconvenience, eat. In twenty hours he consumed, by weight, of sea-horse flesh, hard frozen, 4 lb. 4 oz. the same quantity of boiled flesh, and of bread and bread-dust 1 lb. 12 oz. amounting to 10 lb. 4 oz. of solids. Besides this he took 1¾ pint of rich gravy soup, 3 wine-glasses of raw spirits, 1 tumbler of strong grog, and 1 gallon and a pint of water! Notwithstanding this immense load of food, the lad did not seem to consider the quantity extraordinary. The quantity of water they drank was quite in proportion to their eating; it was so great, indeed, that Captain Parry could by no means furnish them with half as much as they desired.

These people employed the usual canoe; and had, indeed, the general apparatus of the Greenlanders. In their frail Kaijaks, and with so imperfect apparatus, they sometimes attack the whale, and occasionally with success. They were found to be very tolerably in the use of the bow and arrow.

In their dealings and intercourse with our voyagers, these people were more than ordinarily honest, that is, for Esquimaux; and in their barter they were generally fair and upright. They received the most unceasing kindness from both officers and sailors, and were perpetually receiving benefits from them; but their gratitude was very rarely at all excited by it. They in fact, seemed exceedingly deficient in this interesting and important virtue. In the few instances, however, in which the voyagers had occasion to draw upon their hospitality, they had every reason to be pleased with them. Both as to food and accommodation, the best that was to be had were always at their service; and their attention was every thing that hospitality and even good breeding could dictate.

Twelve of the men Captain Parry had met with had each *two* wives, and some of the younger had two betrothed. Children were found to be betrothed in their infancy; a practice rare in Greenland.

The women of this tribe, like the Esquimaux race generally, are not remarkable for their chastity; nor are the husbands at all delicate about it. It is not uncommon, when two of them are together on a sealing excursion, to exchange wives as a friendly accommodation; and they were as little scrupulous of offering their wives to the sailors, at least many of them, as they would have offered for sale a knife or a jacket. In the absence of the men, the women manifested an utter disregard to connubial fidelity. In such a state of society, the curious circumstances that occurred, with the voyagers and Esquimaux, will not be considered surprising. Captain Lyon humorously records a case that happened to himself. In one of his excursions overland, he had occasion to lodge in an Esquimaux tent, where a portion was screened off for him by a seal's skin. Here wrapped in his blanket bag, he retired to rest alone; but, at midnight, was awakened by a feeling of great warmth, and, to his surprise, found himself covered by a large deer skin, under which lay his Esquimaux host, with "his two wives and their favourite puppy, all fast asleep, and stark naked. Supposing this was all according to rule," he quietly resigned himself to sleep.

There was a considerable degree of talent evinced by several of these people. Besides manufacturing all necessary articles of clothing, and some of their apparatus, with great ingenuity and neatness, they readily comprehended the nature of charts, and some of them drew plans on paper of the contiguous coasts, with extraordinary accuracy. A female of the name of Iligliuk was very remarkable for this talent, and, indeed, in all respects, seemed to be a person of very good, if not superior understanding. From this young woman, the first notice respecting the North-East Cape of America was derived, which she pointed out by tracing it with the contiguous coasts on a map in the presence of Captain Parry.

"In their behaviour to old people, where age or infirmities render them useless, and therefore burthensome to the community, the Esquimaux betray a degree of insensibility bordering on inhumanity." Captain Parry was witness of a very distressing example of the same inhumanity to the widow of an Esquimaux who died at Igloolik during their stay there. This poor destitute woman was shamefully treated by her tribe, and even kinsmen, and was discovered by Captain Parry in a dying condition, owing apparently to desertion, robbery, and want. But their whole character was yet considered by our voyagers as much superior to that of persons in general in savage life. Devoid of religion, and particularly of the humanising and elevating principles of Christianity, they were under the influence only of sensual and selfish principles; and under such principles it is not surprising that they were not better. The stay of Captain Parry, and his constant intercourse with them, afforded an admirable opportunity of giving them some knowledge of the great truths of religion; but we are not informed by him whether or not this object was undertaken, and the opportunity improved.

Second Appendix.

The expedition, under the command of Captain Bellingshausen, has added to our knowledge of the south polar regions by the discovery of two islands within the Antarctic circle, the only land hitherto known to exist so far to the southward. Both these islands lie in about 69° south latitude; one of them, named Alexander I. Island, in 73° west longitude, and the other Peter Island, in 91° west. Both of them were so closely enveloped in ice, that no particular examination of them could be made. This expedition, consisting of two ships, the Wostok and the Mirni, sailed on the 3d of July, 1819. They touched at Copenhagen to improve their equipment, and at Portsmouth to take on board the astronomical instruments which had been ordered for them in London, and from thence proceeded to Teneriffe and Rio Janeiro on their way to the southward. The leading object of the voyage was to explore the Antarctic regions, and perform a circuit of the southern pole as near to it as the ice would permit; and avoiding the track of Captain Cook, to make their highest penetration where this navigator had kept at a distance from the ice, and on the contrary to retire into a more northerly parallel, in the meridian where the adventurous Cook had made the most particular examinations. On this judicious plan they succeeded in the discovery of the two islands we have mentioned; but they could not approach within thirty miles of them for ice, and that only on the *west* side. The ice was generally found to lie so far from the pole, that their highest latitude was only 70°, being short of the point reached by Cook. Within the Antarctic circle they traversed a distance of near 30° of longitude; and taking the latitude of 60°, we find that 300 degrees of longitude were traced in the two voyages by Cook and Bellingshausen within this parallel, leaving only 60° of longitude unexplored at this elevation

POLITICAL ECONOMY.

CHAP. I.

OBJECTS AND ORIGIN OF THE SCIENCE.

olitical conomy.

POLITICAL ECONOMY is the name given to an important division of the science of government. The object of government is, or ought to be, the happiness of men united in society; it seeks the means of securing to them the highest degree of felicity compatible with their nature, and at the same time of allowing the greatest possible number of individuals to partake in that felicity. But man is a complex being; he experiences moral and physical wants; therefore his happiness consists in his moral and physical condition. The moral happiness of man, so far as it depends on his government, is intimately connected with the improvement of that government: it forms the object of civil policy, which ought to diffuse the happy influence of liberty, knowledge, virtue, and hope, over all classes of the community. Civil policy should point out the means of giving to nations a constitution, the liberty of which may elevate the souls of the citizens; an education which may form their hearts to virtue, and open their minds to knowledge; a religion which may present to them the hopes of another life, to compensate for the sufferings of this. It should seek not what suits one man, or one class of men, but what may impart most happiness, by imparting most worth, to all the men living under its laws.

The physical well-being of man, so far as it can be produced by his government, is the object of Political Economy. All the physical wants of man, for which he depends on his equals, are satisfied by means of wealth. It is this which commands labour, which purchases respectful service, which procures all that man has accumulated for use or pleasure. By means of it, health is preserved, and life maintained; the wants of infancy and old age are supplied; food, and clothing, and shelter, are placed within the reach of all. Wealth may, therefore, be considered as representing all that men can do for the physical well-being of each other; and the science, which shows to governments the true system of administering national wealth, is an important branch of the science of national happiness.

Government is instituted for the advantage of all the persons subject to it; hence it ought to keep the advantage of them all perpetually in view. And as, in respect of civil policy, it should extend to every citizen the benefits of liberty, virtue, and knowledge, so it ought likewise, in respect of political economy, to watch over all the advantages of the national fortune. Abstractly considered, the end of government is not to accumulate wealth in the state, but to make every citizen participate in those enjoyments of physical life which wealth represents. Government is called to second the work of Providence, to augment the mass of felicity on earth, and not to multiply the beings who live under its laws, faster than it can multiply their chances of happiness.

Political Economy.

Wealth and population are not, indeed, absolute signs of prosperity in a state; they are so only in relation to each other. Wealth is a blessing, when it spreads comfort over all classes; population is an advantage, when every man is sure of gaining an honest subsistence by his labour. But a country may be wretched, though some individuals in it are amassing colossal fortunes; and if its population, like that of China, is always superior to its means of subsistence; if it is contented with living on the refuse of animals; if it is incessantly threatened with famine, this numerous population, far from being an object of envy, is a calamity.

The improvement of social order is generally advantageous to the poor as well as to the rich; and political economy points out the means of preserving this order by correction, but not of overturning it. It was a beneficent decree of Providence, which gave wants and sufferings to human nature; because out of these it has formed the incitements, which are to awaken our activity and push us forward to develop our whole being. If we could succeed in excluding pain from the world, we must also exclude virtue; if we could banish want, we must also banish industry. Hence it is not the equality of ranks, but happiness in all ranks, which the legislator ought to have in view. It is not from the division of property, that he will procure this happiness, but from labour and the reward of labour. It is by maintaining the activity and hopes of the mind; by securing to the poor man as well as to the rich, a regular subsistence and the sweets of life, in the performance of his task.

The title given by Adam Smith to his immortal work, on the science we are now engaged with, '*The Nature and Causes of the Wealth of Nations,*' forms at the same time the most precise definition of that science. It presents a much more exact idea, than the term political economy, afterwards adopted. The latter designation, at least, requires to be understood according to the modern acceptation of the word economy, not according to its etymology. In its present sense, economy denotes the preservative, administrative, and the management of property; and it is because we use the somewhat tautological phrase *domestic economy* for the management of a private fortune, that we have come to use the phrase *political economy* for the management of the national fortune.

From the time when men first entered into social union, they must have occupied themselves with the common interests originating in their wealth. From the beginning of societies, a portion of the public wealth was set apart to provide for the public wants. The levying and management of this national revenue, which no longer pertained to each, became an essential part in the science of statesmen. It is what we call *finance.*

Private fortunes, on the other hand, made the interests of each citizen more complex; being exposed to the attacks of cupidity and fraud, their wealth required to be defended by the public authority, according to the fundamental article of the social contract, which had combined the strength of individuals to protect each with the power of all. The rights over property, the divisions of it, the means of transmitting it, became one of the most important branches of civil jurisprudence; and the application of justice to the distribution of national property, formed an essential function of the legislator.

But no inquiry concerning the nature and causes of national wealth had occupied the speculations of our ancestors. They had not ascended to the principles of political economy, in order to deduce from that source their systems of finance and civil jurisprudence, which ought however to be nothing more than corollaries from those principles. They had abandoned the development of public wealth to the result of individual efforts, without examining their nature; and thus property had long accumulated silently, in each society, by the labour of each artisan to procure his own subsistence, and afterwards his own comforts—before the manner of acquiring and preserving it became an object of scientific speculation. The philosophers of antiquity were engaged in proving to their disciples, that riches are useless for happiness; not in pointing out to governments the laws by which the increase of those riches may be favoured or retarded. The attention of thinking men was at length directed to national wealth, by the requisitions of states, and the poverty of the people. An important change which occurred in the general politics of Europe, during the sixteenth century, almost everywhere overturned public liberty; oppressed the smaller states; destroyed the privileges of the towns and provinces; and conferred the right to dispose of national fortunes on a small number of sovereigns, absolutely unacquainted with the industry by which wealth is accumulated or preserved. Before the reign of Charles V., one half of Europe, lying under the feudal system, had no liberty or knowledge, and no finance. But the other half, which had already reached a high degree of prosperity, which was daily increasing its agricultural riches, its manufactories, and its trade, was governed by men who, in private life, had attended to the study of economy, who in acquiring their own property, had learned what is suitable in that of states; and who governing free communities, to which they were responsible, guided their administrations, not according to their own ambition, but according to the interest of all. Till the fifteenth century, wealth and credit were nowhere to be found but in the republics of Italy, and of the Hanseatic league; the imperial towns of Germany; the free towns of Belgium and Spain, and perhaps also in some towns of France and England, which happened to enjoy great municipal privileges. The magistrates of all those towns were men constantly brought up in business, and without having brought political economy to the form of a science, they had yet the feeling as well as the experience of what would serve or injure the interests of their fellow-citizens.

The dreadful wars which began with the sixteenth century, and altogether overturned the balance of Europe, transferred a nearly absolute authority to three or four all-powerful monarchs, who shared among them the government of the civilized world. Charles V. united, under his dominion, all the countries which had hitherto been celebrated for their industry and wealth, —Spain, nearly all Italy, Flanders, and Germany; but he united after having ruined them; and his administration, by suppressing all their privileges, prevented the recovery of former opulence. The most absolute kings can no more govern by themselves, than kings whose authority is limited by laws. The former transmit their power to ministers, whom they themselves select, in place of taking such as would be nominated by the popular confidence. But they find them among a class of persons different from that in which free governments find them. In the eyes of an absolute king, the first quality of a statesman is his being in possession of a rank so high that he may have lived in noble indolence, or at least in absolute ignorance of domestic economy. The ministers of Charles V. whatever talents they show for negociation and intrigue, were all equally ignorant of pecuniary affairs. They ruined the public finances, agriculture, trade, and every kind of industry, from one end of Europe to the other; they made the people feel the difference, which might indeed have been anticipated, between their ignorance and the practical knowledge of republican magistrates.

Charles V., his rival Francis I., and Henry VIII. who wished to hold the balance between them, had engaged in expences beyond their incomes; the ambition of their successors, and the obstinacy of the house of Austria, which continued to maintain a destructive system of warfare during more than a hundred years, caused those expences, in spite of the public poverty, to go on increasing. But as the suffering became more general, the friends of humanity felt more deeply the obligation laid on them to undertake the defence of the poor. By an order of sequence opposite to the natural progress of ideas, the science of political economy sprung from that of finance. Philosophers wished to shield the people from the speculations of absolute power. They felt that, to obtain a hearing from kings, they must speak to them of royal interests, not of justice or duty. They investigated the nature and causes of national wealth, to show governments how it might be shared without being destroyed.

Too little liberty existed in Europe, to allow those who first occupied themselves with political economy, to present their speculations to the world; and finances were enveloped in too profound a secrecy to admit of men, not engaged in public business, knowing facts enough to form the basis of general rules. Hence the study of political economy began with ministers, when once it had fortunately happened that kings put men at the head of their finances, who combined talents with justice and love of the public weal. Two great French ministers, Sully under Henry IV., and Colbert under Louis XIV., were the first who threw any light on a subject till then regarded as a secret of state, in which mystery had engendered and concealed the greatest absurdities. Yet in spite of all their genius and authority, it was a task beyond their power to introduce any thing like order, precision or uniformity into this branch of government. Both of them, however, not only repressed the frightful spoliations of the revenue farmers, and by their protection communicated some degree of security to private fortunes; but likewise dimly perceived the true sources of national prosperity, and busied themselves with efforts to make them flow more abundantly. Sully gave his chief protection to agriculture. He used to say, that *pasturage and husbandry were the two breasts of the state.* Colbert, descended from a family engaged in the cloth trade, studied above all to encourage manufactures and commerce. He furnished himself with the opinion of merchants, and asked their advice on all emergencies. Both statesmen opened roads and canals to facilitate the exchange of commodities; both protected the spirit of enterprise, and honoured the industrious activity which diffused plenty over their country.

Colbert, the later of the two, was greatly prior to any of the writers who have treated political economy as a science, and reduced it to a body of doctrines. He had a system, however, in regard to national wealth: he required one to give uniformity to his plans, and delineate clearly before his view the object he wished to attain. His system was probably suggested by the merchants whom he consulted. It is now generally known by the epithet *mercantile*, sometimes also by the name *Colbertism*. Not that Colbert was its author, or unfolded it in any publication; but because he was beyond comparison the most illustrious of its professors; because, notwithstanding the errors of his theory, the applications he deduced from it were highly advantageous; and because, among the numerous writers who have maintained the same opinion, there is not one who has shown enough of talent even to fix his name in the reader's memory. It is but just, however, to separate the mercantile system altogether from the name of Colbert. It was a system invented by trading subjects, not by citizens; it was a system adopted by all the ministers of absolute governments, when they happened to take the trouble of thinking on finance, and Colbert had no other share in the matter than that of having followed it without reforming it.

After long treating commerce with haughty contempt, governments had at length discovered in it one of the most abundant sources of national wealth. All the great fortunes in their states did not indeed belong exclusively to merchants; but when, overtaken by sudden necessity they wished to levy large sums at once, merchants alone could supply them. Proprietors of land might possess immense revenues, manufacturers might cause immense labours to be executed; but neither of them could dispose of any more than their income or annual produce. In a case of need, merchants alone offered their whole fortune to the government. As their capital was entirely represented by commodities already prepared for consumption, by merchandise destined for the immediate use of the market to which it had been carried, they could sell it at an hour's warning, and realize the required sum with smaller loss than any other class of citizens. Merchants, therefore, found means to make themselves be listened to, because they had in some sort the command of all the money in the state, and were at the same time nearly independent of authority—being able, in general, to hide from the attacks of despotism a property of unknown amount, and transport it with their persons, to a foreign country, at a moment's notice.

Governments would gladly have increased the merchant's profit, on condition of obtaining a share of it. Imagining that nothing more was necessary than to second each other's views, they offered him force to support industry; and since the advantage of the merchant consists in selling dear and buying cheap, they thought it would be an effectual protection to commerce, if the means were afforded of selling still dearer and buying still cheaper. The merchants whom they consulted eagerly grasped at this proposal; and thus was founded the mercantile system. Antonio de Leyva, Fernando de Gonzago, and the Duke of Alva, viceroys of Charles V. and his descendents—the rapacious inventors of so many monopolies—had no other notion of political economy. But when it was attempted to reduce this methodical robbery of consumers into a system; when deliberative assemblies were occupied with it; when Colbert consulted corporations; when the people at last began to perceive the true state of the case, it became necessary to find out a more honourable basis for such transactions; it became necessary not only to study the advantage of financiers and merchants, but also that of the nation: for the calculations of self-interest cannot show themselves in open day, and the first benefit of publicity is to impose silence on base sentiments.

Under these circumstances, the mercantile system was moulded into a plausible form; and doubtless it must have been plausible, since, even till our own times, it continued to seduce the greater part of practical men employed in trade and finance. Wealth, said those earliest economists, is money: the two words were received into universal use as almost entirely synonymous; no one dreamed of questioning the identity of money and wealth. Money, they said, disposes of men's labour, and of all its fruits. It is money which produces those fruits; it is by means of money that industry continues in a nation; to its influence, each individual owes his subsistence and the continuation of his life. Money is especially necessary in the relation of one state to another. It supports war, and forms the strength of armies. The state which has it, rules over that which has it not. The whole science of political economy ought, therefore, to have for its object the increase of money in a nation. But the money possessed by a nation cannot be augmented in quantity, except by the working of mines, if the nation has any; or by foreign trade, if it has none. All the exchanges carried on within a country, all the purchases and sales which take place among Englishmen, for instance, do not increase the specie contained within the shores of England by a single penny. Hence it is necessary to find means of importing money from other countries; and trade alone can do this, by selling much to foreigners, and buying little from them. For in the same way as each merchant, in settling with his correspondent, sees at the year's end whether he has sold more than he has bought, and finds himself accordingly creditor or debtor by a balance account which must be paid in money; so likewise a nation, by summing up all its purchases and all its sales with each nation, or with all together, would find itself every year creditor or debtor by a commercial balance which must be paid in money. If the country pay this balance, it will constantly grow poorer; if it receive the balance, it will constantly grow richer.

For a century, the mercantile system was universally adopted by cabinets; universally favoured by traders and chambers of commerce; universally expounded by writers, as if it had been proved by the most unexceptionable demonstration, no one deeming it worth while to establish it by new proofs; when, after the middle of the eighteenth century, Quesnay opposed to it his *Tableau Économique*, afterwards expounded by Mirabeau and the Abbé de Rivière, enlarged by Dupont de Nemours, and adopted by a numerous sect, which arose in France, under the name of Economists. In Italy, too, this sect gained some distinguished partisans. Its followers have written more about the science than those of any other sect; yet they have admitted Quesnay's principles with such blind confidence, and maintained them with such implicit fidelity, that one is at a loss to discover any difference of principle, or any progress of ideas in their several productions.

Thus Quesnay founded a second system in political economy, still named the *territorial system*, or more precisely, the system of the economists. He begins by asserting, that gold and silver the signs of wealth, the means of exchange, the price of all commodities, do not themselves constitute the wealth of states; and that no judgment can be formed concerning the prosperity of a nation, from the abundance of its precious metals. He next proceeds to survey the different classes of men, all of whom, occupied in gaining money and causing wealth to circulate, even when acquiring it for themselves, are not, according to him, occupied with any thing besides exchange. He endeavours to distinguish the classes possessed of a creative power; it is amongst them that wealth must originate, all the transactions of commerce appearing to be nothing else but the transmission of that wealth from hand to hand.

The merchant who carries the productions of both hemispheres from one continent to the other, and on returning to the ports of his own country, obtains, at the sale of his cargo, a sum double of that with which he began his voyage, does not, after all, appear in the eyes of Quesnay, to have performed any thing but an exchange. If, in the colonies, he has sold the manufactures of Europe at a higher price than they cost him, the reason is, they were in fact worth more. Together with their prime cost, he must also be reimbursed for the value of his time, his cares, his subsistence, and that of his sailors and agents during the voyage. He has a like reimbursement to claim on the cotton or sugar which he brings back to Europe. If, at the end of his voyage, any profit remains, it is the fruit of his economy and good management. The wages, allowed him by consumers for the trouble he has undergone, are greater than the sum he had expended. It is the nature of wages, however, to be entirely expended by him who earns them; and had this merchant done so, he would have added nothing to the national wealth, by the labour of his whole life; because the produce which he brings back does nothing more than exactly replace the value of the produce given for it, added to his own wages, and the wages of all that were engaged with him in the business.

Agreeably to this reasoning, the French philosopher gave to transport trade the name of economical trade, which it still retains. This species of commerce, he asserts, is not destined to provide for the wants of the nation that engages in it, but merely to serve the convenience of two foreign nations. The carrying nation acquires from it no other profit than wages, and cannot grow rich except by the saving which economy enables it to make on them.

Quesnay, next adverting to manufactures, considers them an exchange, just the same as commerce; but instead of having in view two present values, their primitive contract is, in his opinion, an exchange of the present against the future. The merchandise produced by the labour of the artisan is but the equivalent of his accumulated wages. During his labour, he had consumed the fruits of the earth, and the work produced by him is nothing but their value.

The economist at length directs his attention to agriculture. The labourer appears to him to be in the same condition as the merchant and the artisan. Like the latter, he makes with the earth an exchange of the present against the future. The crops produced by him represent the accumulated value of his labour; they pay his hire, to which he has the same right as the artisan to his wages, or the merchant to his profit. But when this hire has been deducted, there remains a net revenue, which was not to be found in manufactures and commerce; it is what the labourer pays the proprietor for the use of his land. This revenue, Quesnay thinks, is of a nature quite different from any other. It is not wages; it is not the result of an exchange; it is the price of the earth's spontaneous labour, the fruit of nature's beneficence; and since it alone does not represent pre-existent wealth, it alone must be the source of every kind of wealth. Tracing the value of all other commodities, under all its transformations, Quesnay still discovers its first origin in the fruits of the earth. The labours of the husbandman, of the artisan, of the merchant, consume those fruits in the shape of wages, and produce them under new forms. The proprietor alone receives them at their source from the hands of nature herself, and by means of them, is enabled to pay the wages of all his countrymen, who labour only for him.

This ingenious system totally supplanted that of the merchants. The economists denied the existence of that commercial balance to which their antagonists attached so much importance; they asserted the impossibility of that accumulation of gold and silver which the others expected from it; throughout the nation, they could see only proprietors of land, the sole dispensers of the national fortune; productive workmen, or labourers producing the revenue of the former; and a hired class, in which they ranked merchants also—denying to them, as to the artisans, the faculty of producing any thing.

The plans, which these two sects recommended to governments, differed not less than their principles. While the mercantilists wished authority to interfere in every thing, the economists incessantly repeated, *laissez faire et laissez passer,* (let every man do as he pleases, and every thing take its course;) for as the public interest consists in the union of all individual interests, individual interest will guide each man more surely to the public interest than any government can do.

An excessive ferment was excited in France by the system of the economists. The government of that nation allowed the people to talk about public affairs, but not to understand them. The discussion of Quesnay's theory was sufficiently unshackled; but none of the facts or documents in the hands of the administration were presented to the public eye. In the system of the French economists, it is easy to discern the effects produced by this mixture of ingenious theory and involuntary ignorance. It seduced the people, because they were now for the first time occupied with their own public affairs. But, during these discussions, a free nation, possessed of the right to examine its own public affairs, was producing a system not less ingenious, and much better supported by fact and observation;—a system which, after a short struggle, at length cast its predecessors into the shade; for truth always triumphs, in the end, over dreams however brilliant.

Adam Smith, author of this third system, which represents labour as the sole origin of wealth, and economy as the sole means of accumulating it, has, in one sense, carried the science of political economy to perfection at a single step. Experience, no doubt, has disclosed new truths to us; the experience of late years, in particular, has forced us to make sad discoveries; but, in completing the system of Smith, that experience has also confirmed it. Of the various succeeding authors, no one has sought any other theory. Some have applied what he advanced to the administration of different countries; others have confirmed it by new experiments and new observations; some have expanded it by developments, which flow from the principles laid down by him; some have even here and there detected errors in his work; but it has been by following out the truths which he taught, and rectify-ing them by light borrowed from its author. Never did philosopher effect a more complete revolution in any science; for those even who dissent from his doctrine acknowledge his authority; sometimes they attack, solely because they do not understand him; most commonly, they flatter themselves with the belief of still following, even while they contradict him. We shall devote the rest of this Article to explain the science which he taught us; though in an order different from his. We shall arrange it under the six following heads: Formation and Progress of Wealth; Territorial Wealth; Commercial Wealth; Money; Taxes; and Population.

CHAP. II.

FORMATION AND PROGRESS OF WEALTH.

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Man brings into the world with him certain wants, which he must satisfy in order to live; certain desires which lead him to expect happiness from particular enjoyments; and a certain industry or aptitude for labour, which enables him to satisfy the requisitions of both. His wealth originates in this industry; his wants and desires are its employments. All that man values is created by his industry; all that he creates is destined to be consumed in satisfying his wants and desires. But, between the moment of its production by labour, and its consumption by enjoyment, the thing destined for man's use may have an existence more or less durable. It is this thing, this accumulated and still unconsumed fruit of labour, which is called wealth.

Wealth may exist not only without any sign of exchange, or without money, but even without any possibility of exchange, or without trade. Suppose a man to be left on a desert island: the undisputed property of this whole island is not wealth, whatever be the natural fertility of its soil, the abundance of the game straying in its forests, of the fish sporting on its shores, or the mines concealed in its bosom. On the contrary, amid all these benefits presented him by nature, the man may sink to the lowest degree of penury, and die perhaps of hunger. But, if his industry enables him to catch some of the animals that wander in his woods; and if, instead of consuming them immediately, he reserves them for his future wants: if, in this interval, he gets them tamed and multiplied, so that he can live on their milk, or associate them to his labour, he is then beginning to acquire wealth, because labour has gained him the possession of those animals, and a fresh labour has rendered them domestic. The measure of his wealth will not be the price, which he might obtain for his property in exchange; because he is debarred from all exchange; but the length of time during which no farther labour will be requisite to satisfy his wants, compared with the extent of those wants.

By subduing those animals, the man has made them his property and wealth; by subduing the ground, he will, in like manner, convert it into property and wealth. His island is destitute of value so long as no labour has been bestowed on it; but if, instead of consuming its fruits the moment they come to his hand, he reserves them for future want; if he commits them again to the earth, again to be multiplied; if he tills his fields to augment their productive power, or defends them by inclosures from wild beasts; if he plants them with trees, the fruit of which he does not look for till many years have elapsed; he is then creating the value, not only of annual produce raised by his labour from the ground, but also of the ground itself, which he had tamed, as he tamed the wild beasts, and rendered fit to second his exertions. In that case he is rich, and the more so the longer he can suspend his labours without suffering new wants.

Our Solitary, being now liberated from the most pressing of all demands, that of hunger, may devote his exertions to provide lodging and clothes, or to improve those already provided. He will build himself a hut, and fit it out with such furniture as his unaided labour may suffice to construct; he will change the skin and fleeces of his sheep into shoes or coats; and the more convenient his dwelling shall be rendered, the better his storehouse shall be filled with provision for his future food and clothing, the more rich may he call himself.

The history of this man is the history of the human race: labour alone has created all kinds of wealth. However great the beneficence of nature, she gives nothing gratuitously to man; though, when addressed by him, she is ready to lend her assistance in multiplying his powers to an indefinite extent. The history of wealth is, in all cases, comprised within the limits now specified—the labour which creates, the economy which accumulates, the consumption which destroys. An article which has not been wrought, or has not mediately or immediately received its value from labour, is not wealth, however useful, however necessary, it may be for life. An article, which is not useful to man, which does not satisfy any of his desires, and cannot mediately or immediately be employed in his service, is not more entitled to the name of wealth, whatever labour may have been bestowed on producing it. And finally, an article which cannot be accumulated or kept for future consumption is not wealth, though created by labour and consumed by enjoyment.

Before possessing any medium of exchange, before discovering the precious metals which render it so easy to us, our Solitary would ere long learn to distinguish the different kinds of labour in their relation to wealth. Labour producing no enjoyment is useless; labour, whose fruits are naturally incapable of being stored up for future consumption, is unproductive; whilst the only productive kinds of labour—the only kinds producing wealth—are such as leave behind them, in the estimation even of our Solitary, a pledge equal in value to the trouble they have cost. Thus the man, misled by analogy, may have imagined that he could multiply his olive-trees by planting the olives; he may not have known but that the stones would germinate as in other such vegetables; till, after preparing the ground by a complete and fatiguing tillage, experience would teach him that his toil had been useless, for no olive-tree was produced by it. On the other hand, he may have secured his dwelling from wolves and bears; and the labour would be useful but unproductive; for its fruits cannot accumulate. If previously accustomed to civilized life, he may have passed many hours in playing on a flute, saved, we shall suppose, at his shipwreck; the labour would still be useful, and probably regarded as his own pleasure; but it would be as unproductive, and for a like reason, as before. He may have bestowed on the care of his person and health much time, very usefully employed; this will also be quite unproductive of wealth. The Solitary will clearly perceive what difference there is between productive labour and the labour of hours in which he amasses nothing for the future; and, without excluding himself from such occupations, he will call them a loss of time.

Whatever holds of the isolated man, with regard to creating and preserving wealth, is true also of society,—when labour, shared among numerous individuals, is recompensed by wages, while its fruits are distributed by exchange. For the society, as well as for the Solitary, there may be a useless as well as an unproductive kind of labour; and, though both of them be paid, they still preserve their distinct character, since the first corresponds not to the desires or wants of the labourer's employer, and the second admits no accumulation of its fruits. The wage paid to the workmen in either case must not mislead us; it puts the payer of it in the workman's place. The part which we formerly supposed to be performed by a single individual, is now shared among two or more persons; but the result is not altered in the least. The day-labourer who plants olives performs a task which is useless to his employer, though, if he receives his hire, it may be advantageous to himself. The man who defends his master or society against bears or hostile enterprises; who takes charge of the health or the persons of others; who provides the enjoyment of music or dramatic exhibition or dancing, performs, just like the Solitary, a work which is useful because it is agreeable, which is lucrative to him because he receives a hire for his labour, whilst he abandons the enjoyment of it to his employers; but which is unproductive notwithstanding, because it cannot be the object of saving and accumulation. He who paid the wage, no longer has either the wage itself in his possession, or the thing for which he gave it.

Thus labour and economy—the true sources of wealth—exist for the Solitary as well as for the social man, and produce the same kind of advantage to both. The formation of society, however, and with it the introduction of commerce and exchange, were necessary both to augment the productive power of labour, by dividing it, and to afford a more precise aim to economy, by multiplying the enjoyments which wealth procures. Thus men, combined in society, produced more than if each had laboured separately; and they preserve better what they have produced, because they feel the value of it better.

Exchange first arose from superabundance: "Give me that article, which is of no service to you, and would be useful to me," said one of the contracting parties, "and I will give you this in return, which is of no service to me and would be useful to you." Present utility was not, however, the sole measure of things exchanged. Each estimated for himself the selling price, or the trouble and time bestowed in the production of his own commodity, and compared it with the buying price, or the trouble and time necessary for procuring the required commodity by his own efforts; and no exchange could take place till the two contracting parties, on calculating the matter, had each discovered that it was better thus to procure the commodity wanted than to make it for himself. This accidental advantage soon pointed out to both a constant source of advantage in trading, whenever the one offered an article which he excelled in making, for an article which the other excelled in making; for each excelled in what he made often, each was unskilful and slow at what he made but seldom. Now, the more exclusively they devoted themselves to one kind of work, the more dexterity did they acquire in it, the more effectually did they succeed in rendering it easy and expeditious. This observation produced the division of trades; the husbandman quickly perceived, that he could not make as many agricultural tools by himself, in a month, as the blacksmith would make for him in a day.

The same principle which at first separated the trades of the husbandman, shepherd, smith, and weaver, continued to separate those trades into an indefinite number of departments. Each felt that, by simplifying the operation committed to him, he would perform it in a manner still more speedy and perfect. The weaver renounced the business of spinning and dyeing; the spinning of hemp, cotton, wool, and silk, became each a separate employment; weavers were still farther subdivided, according to the fabric and the destination of their stuffs; and at every subdivision, each workman, directing his attention to a single object, experienced an increase in his productive powers. In the interior of each manufactory, this division was again repeated, and still with the same success. Twenty workmen all laboured at the same thing, but each made it undergo a different operation; and the twenty workmen found that they had accomplished twenty times as much work as when each had laboured separately.

Much more work was executed in the world by the division of labour; but, at the same time, much more was required to supply the consumption. The wants and the enjoyments of the Solitary, who laboured for himself, were both very limited. Food, clothing, and lodging, he indeed required; but he did not so much as think of the delicacies, by which the satisfaction of those wants might be converted into pleasure; and still less of the artificial desires, induced by society, which in their gratification become new sources of enjoyment. The Solitary's aim was merely to amass, that he might afterwards repose. Before him, at no great distance, was a point in the accumulation of wealth, beyond which it would have been foolishness to accumulate more, because his consumption could not be increased proportionably. But the wants of the social man were infinite, because the society's labour offered him enjoyment infinitely varied. Whatever wealth he might amass, he could never have occasion to say *it is enough*: he still found means to convert it into pleasure, and to imagine at least that he applied it to his service.

Trade, the generic name given to the total mass of exchanges, complicated the relation required to subsist between production and consumption; yet far from diminishing, it increased its importance. At first, every one procured what he himself intended to consume; but when each had come to work for all, the production of all must be consumed by all; and each, in what he produced, must have an eye to the final demand of the society, for which he destined the fruit of his labour. This demand, though not well ascertained by him, was limited in quantity; for, in order to continue his expenditure, every one must confine it by certain restrictions, and the sum of those private expenditures constituted that of the society.

The distinction between capital and income, which in the Solitary's case was still confused, became essential in society. The social man was under the necessity of adjusting his consumption to his income, and the society of which he formed part, were compelled to observe the same rule; without incurring ruin, they could not annually consume more than their annual income, leaving their capital untouched. All that they produced, however, was destined for consumption; and if their annual products, when carried to the destined market, found no purchaser, reproduction was arrested, and the nation ruined as before. We shall attempt to explain this double relation, at once so essential and so delicate, by showing, on the one hand, how income springs from capital; on the other, how what is income for one may be capital for a second.

To the Solitary, every kind of wealth was a provision made beforehand against the moment of necessity; yet still in this provision he distinguished two things,—the part which it suited his economy to keep in reserve for immediate, or nearly immediate use, and the part which he would not need before the time when he might obtain it by a new production. One portion of his corn was to support him till the next harvest; another portion, set apart for seed, was to bring forth its fruit in the following year.

The formation of society, the introduction of exchange, allowed him almost indefinitely to multiply this seed,—this fruit-bearing portion of accumulated wealth. It is what we name *capital.*

The ground and his animals were all that the isolated man could force to work in concert with him; but, in society, the rich man could force the poor to work in concert with him. After having set apart what corn was necessary till the next harvest, it suited him to employ the remaining surplus of corn in feeding other men, that they might cultivate the ground and make fresh corn for him; that they might spin and weave his hemps and wools; that, in a word, they might take out of his hands the commodity ready for being consumed, and at the expiration of a certain period, return him another commodity of a greater value, likewise destined for consumption. Wages were the price at which the rich man obtained the poor man's labour in exchange. The division of labour had produced the distinction of ranks. The person who had limited his efforts to perform only one very simple operation in a manufacture, had made himself dependent on whoever chose to employ him. He no longer produced a complete work, but merely the part of a work; in which he required not only the co-operation of other workmen, but also raw materials, proper implements, and a trader to undertake the exchange of the article which he had contributed to finish. Whenever he bargained with a master-workman for the exchange of labour against subsistence, the condition he stood in was always disadvantageous, since his need of subsistence and his inability to procure it of himself, were far greater than the master's need of labour; and therefore he almost constantly narrowed his demand to bare necessaries, without which the stipulated labour could not have proceeded; whilst the master alone profited from the increase of productive power, brought about by the division of labour.

The master, who hired workmen, was situated in all points exactly as the husbandman who sows the ground. The wages paid to his workmen were a kind of seed which he entrusted to them, and expected in a given time to bring forth fruit. Like the husbandman, he did not sow all his productive wealth; a part of it had been devoted to such buildings, or machines, or implements, as make labour more easy and productive; just in the way that a part of the husbandman's wealth was devoted to permanent works, destined to render the ground more fertile. It is thus that we see the different kinds of wealth springing up and separating, whilst each exerts a different influence on its own reproduction. The funds of consumption, such as domestic necessaries, do not any longer produce fruit, after each has secured them for his own use; fixed capital, such as improvements of the soil, canals of irrigation, and machinery, during the progress of its own slow consumption, co-operates with labour of which it augments the products; and, lastly, circulating capital, such as seed, wages, and raw materials, destined to be wrought, is consumed annually or even more rapidly, in order to be again reproduced. It is essentially important to remark, that those three kinds of wealth are all equally advancing towards consumption. But the first when consumed is absolutely destroyed; for societies, as for individuals, it is merely an expence: whereas the second and third, after being consumed, are reproduced under a new form; and for societies, as for individuals, the consumption of them is a putting out to profit, or the circulation of capitals.

We shall better understand this movement of wealth, which perhaps it is difficult to follow, by fixing our observation on a single family engaged in the simplest of all speculations. A solitary farmer has reaped a hundred bags of corn, and is destitute of any market to which he can carry it. At all events, this corn must be consumed within the year, otherwise it will be worth nothing to the farmer. But he and his family may require only thirty bags of it; this is his expence: another thirty may be employed to support workmen engaged in felling the forests, or draining the marshes of the neighbourhood to put them under culture; this will be converting thirty bags into fixed capital: and, finally, the remaining forty bags may be sown, and formed into a circulating capital, in place of the twenty bags sown the preceding year. The hundred bags are thus consumed; but seventy of them are put out to profit, they will reappear partly at the next harvest, partly at those which follow. By this means, in consuming he will have saved. Yet the limits of such an operation are easily discerned. If this year, out of the hundred bags which he reaped, he could get no more than sixty eaten, who will eat the two hundred bags produced next year by the augmentation of his seed[*]?

Resuming these three sorts of wealth, which, as we have seen, become distinct in a private family, let us now consider each sort with regard to the whole nation, and see how the national revenue may arise from this division.

As the farmer required a primitive quantity of labour to be expended in cutting down the forests, and draining the marshes which he meant to cultivate; so, for every kind of enterprise, there is required a primitive quantity of labour to facilitate and augment the circulating capital. The ore cannot be obtained till the mine is opened; canals must be dug, machinery and mills must be constructed, before they can be used; manufactories must be built, and looms set up, before the wool, the hemp, or the silk can be weaved. This first advance is always accomplished by labour; this labour is always represented by wages; and these wages are always exchanged for necessaries of life, which the workmen consume in executing their task. Hence what we have called fixed capital, is a part of the annual consumption, transformed into durable establishments, calculated to increase the productive power of future labour. Such establishments themselves grow old, decay, and are slowly consumed in their turn, after having long contributed to augment the annual production.

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[*] *His family, which will multiply*, it may be said, in answer. Doubtless: but human generations do not grow so fast as food. This is the reverse of what Mr. Malthus has advanced. We shall afterwards examine this discrepancy.

As the farmer required seed, which, after being committed to the earth, was returned fivefold in harvest; so likewise, every undertaker of useful labour requires raw materials to work upon, and wages for his workmen, equivalent to the necessaries of life consumed by them in their labour. His operations thus begin with a consumption; and this is followed by a reproduction which should be more abundant, since it must be equivalent to the raw materials worked upon, to the necessaries of life consumed by his workmen in their labour, to the sum by which his machinery and all his fixed capitals have been deteriorated during the production, and lastly to the profit of all concerned in the labour, who have supported its fatigues solely in the hope of gaining by it. The farmer sowed twenty bags of corn to reap a hundred; the manufacturer will make a calculation nearly similar. And as the farmer at harvest must recover not only a compensation for his seed, but likewise for all his labours, so the manufacturer must find in his production, not the raw materials only, but all the wages of his workmen, all the interests and profits of his fixed capital, with all the interests and profits of his circulating capital.

In the last place, the farmer may augment his seed every year; but he will not fail to recollect that, since his crops increase in the same necessaries, he is not sure of always finding men to eat them. The manufacturer, in like manner, devoting the savings of each year to increase his reproduction, must recollect the necessity of finding purchasers and consumers for the increasing products of his establishment.

Since the fund destined for consumption no longer produces any thing, and since each man strives incessantly to preserve and augment his fortune; each will also restrict his consumable fund, and instead of accumulating in his house a quantity of necessaries greatly superior to what he can consume, he will augment his fixed or circulating capital by all that he does not expend. In the present condition of society, a part of the fund destined for consumption remains in the retail-dealer's hand, awaiting the buyer's convenience; another part destined to be consumed very slowly, as houses, furniture, carriages, horses, continues in the hands of persons whose business it is to sell the use of it, without abandoning the property. A considerable portion of the wealth of opulent nations is constantly thrown back into the funds destined for consumption; but although it still gives profit to its holders, it has ceased to augment the national reproduction.

The annual distribution of the wealth, annually reproduced, among all the citizens composing the nation, constitutes the national revenue. It consists of all the value, by which the reproduction surpasses the consumption that produced it. Thus the farmer, after deducting from his crop a quantity equal to the seed of the foregoing year, finds remaining the part which is to support his family,—a revenue to which they have acquired right by means of their annual labour; the part which is to support his workmen, who have acquired right to it by the same title; the part with which he is to satisfy the landlord, who has acquired right to this revenue by the original improvement of the soil, now no longer repeated; and lastly, the part with which he is to pay the interest of his debts, or indemnify himself for the employment of his own capital, —a revenue to which he has acquired right by the primitive labours which produced his capital.

So likewise the manufacturer finds, in the annual produce of his manufactory, first the raw material employed; secondly, the equivalent of his own wages, and those of his workmen, to which their labour alone gives them right; thirdly, an equivalent for the annual detriment and interest of his fixed capital, to which revenue he or the proprietor has acquired right by a primitive labour; and lastly, an equivalent for the interest of his circulating capital, which has been produced by another primitive labour.

It is to be observed that, among those who share the national revenue, some acquire a new right in it every year by a new labour, others have previously acquired a permanent right by a primitive labour, which has rendered the annual labour more advantageous. No one obtains a share of the national revenue, except in virtue of what he himself or his representatives have accomplished to produce it; unless, as we shall soon see, he receives it at second hand, from its primitive proprietors, by way of compensation for services done to them. Now, whoever consumes without fulfilling the condition which alone gives him right to the revenue; whoever consumes without having a revenue, or beyond what he has; whoever consumes his capital in place of revenue, is advancing to ruin; and a nation composed of such consumers is advancing to ruin likewise. Revenue, indeed, is that quantity by which the national wealth is increased every year, and which accordingly may be destroyed, without the nation's becoming poorer; but the nation which, without reproduction, destroys a quantity of wealth, superior to this annual increase, destroys the very means by which it would have acquired an equal reproduction in subsequent years.

By a circular concatenation, in which every effect becomes a cause in its turn, production gives revenue, revenue furnishes and regulates a consumable fund, which fund again causes production and measures it. The national wealth continues to augment, and the state to prosper, so long as these three quantities, which are proportional to each other, continue to augment in a gradual manner; but whenever the proportion among them is broken, the state decays. A derangement of the mutual proportion subsisting among production, revenue, and consumption, becomes equally prejudicial to the nation, whether the production give a revenue smaller than usual, in which case a part of the capital must pass to the fund of consumption; or whether, on the contrary, this consumption diminish, and no longer call for a fresh production. To cause distress in the state, it is enough that the equilibrium be broken. Production may diminish, when habits of idleness gain footing among the labouring classes; capital may diminish, when prodigality and luxury become fashionable; and lastly, consumption may diminish from causes of poverty unconnected with the diminution of labour, and yet, as it will not offer employment for future reproduction, it must diminish labour in its turn.

Thus nations incur dangers that seem incompatible: they fall into ruin equally by spending too much, and by spending too little. A nation spends too much whenever it exceeds its revenue, because it cannot do so except by encroaching on its capital, and thus diminishing future production; it then does what the solitary cultivator would do if he should eat the corn which ought to be secured for seed. A nation spends too little, whenever, being destitute of foreign commerce, it does not consume its own production; or when, enjoying foreign commerce, it does not consume the excess of its production above its exportation; for if so, it soon comes into the condition of the solitary cultivator, who having filled all his granaries far beyond the probability of consumption, would be obliged, that he might not work in vain, partly to abandon his cultivation of the ground.

The nation does not indeed spend all that it consumes; the name expenditure in such a case can properly be given to that consumption only which produces nothing; while that part of the consumption, which represents the wages of productive workmen, is an employment of funds, not an expenditure. Thus the nation, when it forms manufacturing establishments, does not diminish its consumption; it consumes, in a productive manner, what it formerly consumed unproductively. Still, however, this employment of the national produce in giving movement to new labour, though it does not destroy the balance between production and consumption, renders it much more complex. The new produce thus obtained must at last find a consumer; and though it may be generally affirmed, that to increase the labour is to increase the wealth, and with it in a similar proportion the revenue and the consumption; still it is any thing but proved, that by too rapid an increase of its labour, a nation may not altogether deviate from the proper rate of consumption, and thus ruin itself by economy as well as prodigality. Happily, in most cases, the increase of capital, of revenue, and of consumption requires no superintendence; they proceed of their own accord with an equal pace; and when one of them, at any time, happens to pass the others for an instant, foreign commerce is almost always ready to restore the equilibrium.

We have designedly carried on our history of the formation and progress of wealth thus far, without mentioning a circulating medium, to show that in fact such an instrument is not necessary for its development. A circulating medium did not create wealth; but it simplified all the relations, and facilitated all the transactions of commerce: it gave to each the means of finding sooner what suited him best; and thus presenting an advantage to every one, it still farther increased the wealth, which was already increasing without it.

The precious metals are one of the numerous values produced by the labour of man, and applicable to his use. It was soon discovered that they, more than any other species of riches, possessed the property of being preserved without alteration for any length of time, and the no less valuable one of uniting easily into a single whole, after being divided almost infinitely. The two halves of a piece of cloth, of a fleece, and still less of an ox,—though these are supposed to have once been employed as money—were not worth the whole; but the two halves, the four quarters of a pound of gold, are always, and will be a pound of gold, however long they may be kept. As the first exchange of which men feel the need, is that which enables them to preserve the fruit of their labour for a future season, every one became eager to get precious metals in exchange for his commodity, whatever it might be; not because he at all intended to use those metals himself, but because he was sure of being able to exchange them at any time afterwards, in the same manner, and for the same reason, against whatever article he might then need. From that time, the precious metals began to be sought after, not that they might be employed in the use of man as ornaments or utensils, but that they might be accumulated, at first, as representing every species of wealth, and then that they might be used in commerce as the means of facilitating all kinds of exchange.

Gold dust, in its primitive state, continues even now to be the medium of exchange among the African nations. But when once the value of gold comes to be universally admitted, there remains but a single step, much easier and far less important, till it be converted into coin, which warrants, by a legal stamp, the weight and the fineness of every particle of the precious metals employed in circulation.

The invention of money gave quite a new activity to exchange. Whoever happened to possess any superfluity had no longer occasion to seek the article likely to be needed in time to come. He no longer delayed selling his corn till he should meet the oil-merchant or the wool-dealer to offer them the thing they wanted; he reckoned it enough to find money, being certain that for this he could always obtain any required commodity. The buyer, too, on his side needed not to study what would suit the seller; money was always sure to satisfy all his demands. Before the invention of a circulating medium, a fortunate concurrence of conveniences was requisite for an exchange; whereas after this invention, there could scarcely be a buyer who did not find a seller, or a seller who did not find a buyer.

As exchanges, and afterwards sales and purchases were voluntary, it might be inferred that all values were given for values completely equal. It is more correct, however, to say that bargains were never made without advantages to both parties. The seller found a profit in selling, the buyer in buying. The one drew more advantages from the money which he received, than he would have done from his merchandise; the other more advantage from the merchandise which he acquired, than he would have done from his money. Both parties had gained, and hence the nation gained doubly by their bargain. On the same principle, when a master set any workman to labour, and gave him in exchange for the work expected to be done, a wage which corresponded to the workman's maintenance during his labour; both those contractors gained;—the workman, because he had received in advance the fruit of his labour, before it was accomplished;—the master, because this workman's labour was worth more than his wages. The nation gained with both; for as the national wealth must at the long run be realized in enjoyment, whatever augments the enjoyment of individuals, must be considered as a gain for all.

Thus the labour of man created wealth; but wealth, in its turn, created the labour of man. Wherever wealth offered a profit, a wage, a subsistence, it produced a class of men eager to acquire them. The accumulation of primary labour had created the value of land, by unfolding its productive power. This power, as it seconded the labour of man, henceforth became a species of wealth; and a person possessed of land might, without himself labouring, obtain payment for surrendering the use of it to such as laboured. Hence the origin of sales and leases of land. The farmer again might hire workmen to labour, and thus might acquire the advantages attached to exchanging present subsistence against distant produce. He incurred all the charges of cultivation, he drew all its profits, and left to his workmen nothing but their wages. Thus the revenues of land, all comprised in the annual crop, were divided among three classes of men, under the name of rent, profit, and wages; whilst a surplus included the seed and the farmer's advance.

The manufacturer again possessed machinery and materials; he offered to his labourers an immediate subsistence for the fruit of a labour, which required time and long advances. He enabled them to live, he furnished them with lodging, tools, machinery, and paid himself with interest by their work. If in his own hand, he had not enough of accumulated wealth, or enough of the money which represents it, to provide his workmen with all the advances which their enterprise required, and to wait for the sale of their labour; he borrowed money and paid the lender an interest analogous to the rent which the farmer pays his landlord. The labour of the workmen employed by him annually produced a certain quantity of goods, in the value of which were to be included the interest of capital for the money-lender, the rent of implements, machines, immoveables, and all kinds of fixed capital; the profits of the head manufacturer, the wages of his workmen, and, lastly, the capital expended in raw materials, together with the whole of that capital which, as it circulates annually in the manufactory, must be deducted from its annual produce, in order to leave the net revenue.

The produce of the soil and of manufactories belonged often to climates very distant from those inhabited by their consumers. A class of men undertook to facilitate all kinds of exchange, on condition of sharing in the profits which it yields. These men gave money to the producer, at the time when his work was finished and ready for sale; after which having transported the merchandise to the place where it was wanted, they waited the consumer's convenience, and retailed to him in parcels what he could not purchase all at once. They did service to every one, and repaid themselves for it by the share which is named profits of trade. The advantage arising from a judicious management of exchanges was the origin of those profits. In the north, a producer reckoned two measures of his merchandise equivalent to one of southern merchandise. In the south, on the other hand, a producer reckoned two measures of his merchandise equivalent to one of northern merchandise. Between two equations so different there was room to cover all the expences of transport, all the profits of trade, and interest for all the money advanced to carry it on. In fact, at the sale of such commodities transported by commerce, there must be realized, first the capital repaid to the manufacturer; then the wages of the sailors, carriers, clerks, and all persons employed by the trader; next the interest of all those funds to which he gives movement; and, lastly, the mercantile profit.

Society requires something more than wealth; it would not be complete, if it contained nothing but productive labourers. It requires administrators, judges, lawgivers; men employed about its general interests; soldiers and sailors to defend it. No one of those classes produces any thing; their labour never assumes a material shape; it is not susceptible of accumulation. Yet without their assistance, all the wealth arising from productive labour would be destroyed by violence; and work would cease, if the labourer could not calculate on peaceably enjoying its fruits. To support this guardian population, a part must be deducted from the funds created annually by labour. But as the service done to the community, by such persons, how important soever it be, is felt by no one in particular, it cannot, like other services, be an object of exchange. The community itself was under the necessity of paying it, by a forced contribution from the revenues of all. It was not long, indeed, till this contribution came to be regulated by the persons destined to profit from it; and hence the contributors were loaded without measure; civil and military offices were multiplied far beyond what the public weal required; there was too much government, too much defence of men, who were forced to accept those services, and to pay them, superfluous or even burdensome as they might be; and the rulers of nations established to protect wealth, were often the main authors of its dilapidation.

Society needs that kind of labour which produces mental enjoyments; and as mental enjoyment are nearly all immaterial, the objects destined to satisfy them cannot be accumulated. Religion, science, the arts, yield happiness to man; their origin is labour, their end enjoyment; but what belongs only to the soul is not capable of being treasured up. If a nation, however, does not reckon literature and the arts among its wealth, it may reckon literary men and artists; the education they receive, the distinction they acquire accumulate a high value on their heads: and the labour which they execute being often better paid than that of the most skilful workmen, may thus contribute to the spread of opulence.

Society, in the last place, needs those kinds of labour the object of which is to take care of the persons, not the fortunes of men. Such labour may be of the most elevated, or of the most servile kind; according as it requires either the knowledge of nature and the command of her secrets, like the physician's labour, or merely complaisance and obedience to the will of a master, like the footman's labour. All of them are species of labour intended for enjoyment, and differing from productive labour, only in so far as their effects are incapable of accumulation. Hence, though they add to the well-being of a state, they do not add to its wealth; and such as are employed in them must live on voluntary contributions drawn from the revenue formed by other kinds of labour.

CHAP. III.

OF TERRITORIAL WEALTH.

Of territorial wealth.

The riches proceeding from land should be the first to engage the attention of an economist or a legislator. They are the most necessary of all, because it is from the ground that our subsistence is derived; because they furnish the materials for every other kind of labour; and lastly, because, in preparation, they constantly employ the half, often much more than the half, of all the nation. The class of people who cultivate the ground are particularly valuable for bodily qualities fitted to make excellent soldiers, and for mental qualities fitted to make good citizens. The happiness of a rural population is also more easily provided for than that of a city population; the progress of this kind of wealth is more easily followed; and government is more culpable when it allows agriculture to decay, because it almost always lies in the power of government to make it flourish.

The annual revenue of land, or the annual crop, is decomposed, as we observed above, in the following manner. One part of the fruits, produced by labour, is destined to pay the proprietor for the assistance which the earth has given to the labour of men, and also for the interest of all the capital successively employed to improve the soil. This portion alone is called the net revenue. Another part of the fruits replaces what has been consumed in executing the labour to which the crop is due, the seed and all the cultivator's advances. Economists call this portion *the resumption*. Another part remains for a profit to the person who directed the labours of the ground: it is proportionate to his industry, and the capital advanced by him. Government likewise takes a share of all those fruits, and by various imposts, diminishes the proprietor's rent, the cultivator's profit, and the day-labourer's wages, in order to form a revenue for another class of persons. Nor do the fruits, distributed among the workmen, the superintendent of the labour, and the proprietor, entirely remain with them in kind: after having kept a portion requisite for their subsistence, the whole then equally part with what remains, in exchange for objects produced by the industry of towns; and it is by means of this exchange, that all other classes of the nation are supplied with food.

The net revenue of territorial produce is considered to be that portion, which remains with proprietors after the expences of cultivation have been paid. Proprietors frequently imagine that a system of cultivation is the better, the higher those rents are: what concerns the nation, however, what should engage the economist's undivided attention, is the gross produce, or the total amount of the crop; by which subsistence is provided for the whole nation, and the comfort of all classes is secured. The former comprehends but the revenue of the rich and idle; the latter farther comprehends the revenue of all such as labour, or cause their capital to labour.

But a gradual increase of the gross produce may itself be the consequence of a state of suffering,—if the population, growing too numerous, can no longer find a sufficient recompence in the wages of labour, and if, struggling without protection against the proprietors of land, to whom limitation of number gives all the advantage of a monopoly, that population is reduced to purchase by excessive labour so small an augmentation of produce, as to leave it constantly depressed by want. There is no department of political economy, which ought not to be judged in its relation to the happiness of the people in general; and a system of social order is always bad when the greater part of the population suffers under it.

Commercial wealth is augmented and distributed by exchange; and even the produce of the ground, so soon as it is gathered in, belongs likewise to commerce. Territorial wealth, on the other hand, is created by means of permanent contracts. With regard to it, the economist's attention should first be directed to the progress of cultivation; next to the mode in which the produce of the harvest is distributed among those who contribute to its growth; and lastly, to the nature of those rights which belong to the proprietors of land, and to the effects resulting from an alienation of their property.

The progress of social order, the additional security, the protection which government holds out to the rights of all, together with the increase of population, induce the cultivator to entrust to the ground, for a longer or shorter period, the labour which constitutes his wealth. In the timorous condition of barbarism, he will not, at his own expense, increase the value of an immoveable possession, which perhaps he may be forced to abandon at a moment's warning. But in the security of complete civilization, he regards his immoveable possessions as more completely safe than any other kind of wealth. In the deserts of Arabia and Tartary; in the savannahs of America, before civilization has begun; in the pastures of the Campagna di Roma, or the Capitanata de la Pouille, after it has ended, men are contented with the natural fruits of the ground, with grass for their cattle to browse; and if those vast deserts yet retain any value, they owe it less to the slight labour by which the proprietor has inclosed them, than to the labour by which the herdsman has multiplied the oxen and sheep which feed upon them.

When the population of such deserts has begun to increase, and an agricultural life to succeed that of shepherds, men still abstain from committing to the ground any labour, whose fruit they cannot gather till after many years have elapsed. The husbandman tills, to reap in the following season; the course of a twelvemonth is sufficient to give back all his advances. The earth which he has sown, far from gaining a durable value by his labour, is for a time impoverished by the fruits it has borne. Instead of seeking to improve it by more judicious cultivation, he gives it back to the desert for repose, and next year tills another portion. The custom of fallowing, a remnant of this half savage mode of agriculture, continues to our own time in more than three-fourths of Europe.

But when population and wealth have at last increased, so as to make every kind of labour easy, and when social order inspires security enough to induce the husbandman to fix his labour in the ground, and transmit it with the soil to his descendants, improvement altogether changes the appearance of the earth. Then are formed those plantations of gardens, orchards, vineyards, the enjoyment of which is destined for a late posterity; then are dug those canals for draining or irrigation, which diffuse fertility; then arise upon the hills those hanging terraces, which characterized the agriculture of ancient Canaan. A quick rotation of crops of a different nature reanimates, instead of exhausting, the strength of the soil; and a numerous population lives on a space, which, according to the primitive system, would hardly have supported a few scores of sheep.

The trade or the manufactures of a country are not to be called prosperous, because a small number of merchants have amassed immense fortunes in it. On the contrary, their extraordinary profits almost always testify against the general prosperity of the country. So likewise, in countries abandoned to pasturage, the profits realized by some rich proprietors ought not to be regarded as indicating a judicious system of agriculture. Some individuals, it is true, grow rich; but the nation which the land should maintain, or the food which should support it, are nowhere to be found. It is not even certain, that the net produce of the land may not diminish, in proportion as its agriculture yields a more abundant gross produce, and a greater number of citizens live on its fruits; just as we see the net produce of money, or its interest, diminish in proportion as a country becomes more commercial, and contains more capital.

The first proprietors of land were doubtless themselves cultivators, and executed all kinds of field labour, with their children and servants. To these, in ancient times, were added slaves; the continual state of war, which exists among semi-barbarous societies, having introduced slavery at the remotest era. The stronger found it more convenient to procure workmen by the abuse of victory than by bargain. Yet so long as the head of each family laboured along with his children and slaves, the condition of the latter was less wretched; the master felt himself to be of the same nature with his servant; he experienced the same wants and the same fatigue; he desired the same pleasures, and knew by experience that he would obtain little work from a man whom he fed badly. Such was the patriarchal mode of cultivation, that of the golden days of Italy and Greece; such is that of free America; such appears to be that of Africa in its interior; and such, finally, but without slavery, and therefore with still more domestic comfort, is that of Switzerland, where the peasant proprietor is happier than in any other country of the world.

Among the states of antiquity, the farms under cultivation were small; and the number of freemen labouring in the fields always greatly surpassed that of slaves. The former had a full enjoyment of their persons and the fruits of their labour; the latter, degraded rather than unhappy, like the ox, man's companion, which interest teaches him to spare, seldom experienced suffering, want still more rarely. The head of each family alone receiving the total crop, did not distinguish the rent from the profit or the wages; with the excess of what he wanted for food, he procured the produce of the town in exchange, and this excess supported all other classes of the nation.

But the progress of wealth, of luxury, and idleness, in all the states of antiquity, substituted the servile for the patriarchal mode of cultivation. The population lost much in happiness and number by this change; the earth gained little in productiveness. The Roman proprietors extending their patrimonies by the confiscated territories of vanquished states, the Greeks by wealth acquired from trade,—first abandoned manual labour, and soon afterwards despised it. Fixing their residence in towns, they entrusted the management of their estates to stewards and inspectors of slaves; and from that period, the condition of most part of the country population became intolerable. Labour, which had once been a point of communion betwixt the two ranks of society, now became a barrier of separation; contempt and severity succeeded to affectionate care; punishments were multiplied as they came to be inflicted by inferiors, and as the death of one or several slaves did not lessen the steward's wealth. Slaves who were ill-fed, ill-treated, ill-recompensed, could not fail to lose all interest in their master's affairs, and almost all understanding. Far from attending to their business with affection, they felt a secret joy every time they saw their oppressor's wealth diminished, or his hopes deceived. The study of science, accompanied with habits of observation, certainly advanced the theory of agriculture; but its practice, at the same time, rapidly declined; a fact, which all the agricultural writers of antiquity lament. The cultivation of land was entirely divested of that intelligence, affection, and zeal, which had once hastened its success. The revenues were smaller, the expences greater; and from that period it became an object to save labour, more than to augment its produce. Slaves, after having driven every free cultivator from the fields, were themselves rapidly decreasing in number. During the decline of the Roman empire, the population of Italy was not less reduced than that of the *Agro Romano* is in our days; while at the same time it had sunk into the last degree of wretchedness and penury. The cultivation of the colonies situated on the Mexican Gulf, was founded, in like manner, on the baneful system of slavery; it has in like manner consumed the population, debased the human species, and deteriorated the system of agriculture. The negro trade has of course filled up those voids, which the barbarity of planters annually produced in the agricultural population; and doubtless, under a system of culture, such that the man who labours is constantly reduced below the necessaries of life, and the man who does not labour keeps all for himself, the net produce has always been considerable; but the gross produce, with which alone the nation is concerned, has uniformly been inferior to what would have arisen from any other system of cultivation, whilst the condition of more than seven-eighths of the population has continued to be miserable.

The invasions of the Roman empire, by the barbarians, introduced new manners, and, with them, new systems of cultivation. The conqueror, who had now become proprietor, being much less allured by the enjoyments of luxury, had need of men still more than of wealth. He had ceased to dwell in towns, he had established himself in the country; and his castle formed a little principality, which he wished to be able to defend by his own strength, and thus he felt the necessity of acquiring the affection of such as depended on him. A relaxation of the social bond, and the independence of great proprietors, produced the same effects without the limits of the ancient Roman empire as within. From the epoch of its downfall, masters in every part of Europe began to improve the condition of their dependents; and this return to humanity produced the natural effect; it rapidly increased the population, the wealth, and the happiness of rural labourers.

Different expedients were resorted to for giving slaves and cultivators an interest in life, a property, and an affection for the place of their nativity, as well as for its lord. Adopted by various states, these expedients produced the most decisive influence on territorial wealth and population. In Italy, and part of France and Spain, and probably in most part of the former Roman empire, the master shared the land among his vassals, and agreed with them to share the crops in a raw state. This is cultivation for half produce. In Hungary, Poland, Bohemia, and all that portion of Germany occupied by Sclavonic tribes, the master much more rarely enfranchised his slaves. Keeping them always under an absolute dependance, as serfs attached to the soil, he gave them, however, one half of his land, reserving the other to himself. He wished to share, not the fruits of their labour, but their labour itself, and therefore he obliged them to work for him two, three, and in Transylvania, four days of each week. This is cultivation by *corvées*. In Russia, and several provinces of France and England, masters likewise distributed their lands among vassals; but, instead of wishing to participate either in the lands or the harvests, they imposed a fixed capitation. Such was the abundance of uncultivated land always ready to be cleared, that, in the eyes of those proprietors, the only difference in the condition of agricultural families was the number of workmen included in them. To capitation was always joined the obligation of personal services, and the vassal's continuance in a servile state.

Yet, according as the laws watched more or less strictly over the subject's liberty, cultivation upon this principle raised the husbandman to a condition more or less comfortable. In Russia, he never escaped from servitude of the soil; in England, by an easy transition, he arrived at the rank of farmer.

The system of cultivation by *metayers*, or cultivation at half-produce, is perhaps one of the best inventions of the middle ages. It contributes, more than any thing else, to diffuse happiness among the lower classes, to raise land to a high state of culture, and accumulate a great quantity of wealth upon it. It is the most natural, the easiest, and most advantageous step for exalting the slave to the condition of a freeman, for opening his understanding, teaching him economy and temperance, and placing in his hands a property which he will not abuse. According to this system, the peasant is supposed to have no capital, or scarcely any; but he receives the land sown and fully stocked; he takes the charge of continuing every operation, of keeping his farm in the same state of culture, of delivering to his master the half of each crop; and, when the lease expires, of returning the land under seed, the folds furnished, the vines propped, and every thing, in short, in the same state of completeness as it was when he received it.

A metayer finds himself delivered from all those cares which, in other countries, weigh heavily on the lower class of the people. He pays no direct tax, his master alone is charged with it; he pays no money-rent, and therefore he is not called to sell or to buy, except for his own domestic purposes. The term, at which the farmer has to pay his taxes or his rent, does not press the metayer; or constrain him to sell before the season, at a low price, the crop which rewards his industry. He needs but little capital, because he is not a dealer in produce; the fundamental advances have been made once for all by his master; and as to the daily labour, he performs it himself with his family; for cultivation upon this principle brings constantly along with it a great division of the land, or what is called cultivation on the small scale.

Under this system, the peasant has an interest in the property, as if it were his own; without the anxieties of wealth, he finds in his farm every enjoyment, with which nature's liberality rewards the labour of man. His industry, his economy, the development of his understanding, regularly increase his little stock. In good years, he enjoys a kind of opulence; he is not entirely excluded from the feast of nature which he prepares; his labour is directed according to the dictates of his own prudence, and he plants that his children may gather the fruit. The high state of culture to be found in the finest parts of Italy, above all of Tuscany, where the lands are generally managed in this way; the accumulation of an immense capital upon the soil; the invention of many judicious rotations, and industrious processes, which an intelligent, observing spirit alone could have deduced from the operations of nature; the collection of a numerous population, upon a space very limited and naturally barren, shows plainly enough that this mode of cultivation is as profitable to the land itself as to the peasant, and that, if it imparts most happiness to the lower class who live by the labour of their hands, it also draws from the ground the most abundant produce, and scatters it with most profusion among men.

But whenever a country arrives at complete civilization, whenever the property and safety of individuals are sufficiently protected, the usual population increases beyond what husbandry can employ; the extent of land is limited, the population is not so. A great number of families are brought up on one farm, and sent away by some accidental cause; penury compels them to offer their services, to some proprietor, for a recompence smaller than what is given to such as are actually employed. Labourers outbid each other, and at length go so far as to content themselves with the most niggardly subsistence, with a portion which is barely sufficient in good years, and which in bad years leaves them a prey to famine. This foolish species of competition has reduced the peasantry, on the coast of Genoa, in the republic of Lucca, in several provinces of the kingdom of Naples, to content themselves with a third of the crop, in place of a half. In a magnificent country, which Nature has enriched with all her gifts; which art has adorned with all its luxury; which annually gives forth a most abundant harvest—the numerous class that produce the fruits of the ground never taste the corn which is reaped, or the wine which is pressed, by their labour, and struggle continually with famine. The same misfortune would probably have happened to the people of Tuscany, if public opinion had not guarded the farmer; but there no proprietor dares to impose terms unusual in the country; and when he changes one metayer for another, he changes no article of the primitive contract. So soon, however, as public opinion becomes necessary for the maintenance of public prosperity, it ought, in strict propriety, to be sanctioned by law. Whenever vacant lands are no longer to be found, proprietors of the soil come to exercise a kind of monopoly against the rest of the nation; and wherever monopoly exists, the legislature ought to interpose, lest they who enjoy may also abuse it.

Cultivation by *corvées* was very far from being as happy an invention. No doubt it gave to the peasantry a kind of property, an interest in life; but it reduced them to see their domestic economy disturbed every moment, by the vexatious demands of a landlord or his stewards. The peasant could not perform the operations of his husbandry at the day fixed upon; the landlord's work must always be done before his own; the rainy days constantly fell to the share of the weaker party. Under this system, the labourer performs every service for his master with repugnance, without care for its success, without affection, and without reward. In the landlord's fields, he works as badly as he can without incurring punishment. The steward, on the other hand, declares it absolutely necessary that corporal penalties be employed; and the infliction of them is abandoned to his own discretion. Servitude of the soil has nominally been abolished in several countries, which have adopted the system of cultivation by corvées; but so long as this general system of agriculture is in force, there cannot be any liberty for the peasant. And although the abolition of servitude has given vassals a property and rights, which the landlord did not formerly acknowledge, it has hardly at all bettered their conditions. They are as constantly thwarted and disturbed in their own operations as before; they work quite as ill during the landlord's days; they are quite as miserable within their huts; and the master, who had been flattered with hopes that the abolition of slavery would increase his revenue, has derived no advantage from it. On the contrary, he is ever an object of hatred and distrust to his vassals; and social order, threatened so incessantly, cannot be maintained except by violent means.

The ground of the metayer's contract is every way the same, as that of a contract with the cultivator by corvées. The landlord in Hungary, as in Italy, has given up his land to the peasant, on condition of receiving half its fruits in return. In both countries, the other half has been reckoned sufficient for supporting the cultivator, and repaying his advances. A single error in political economy has rendered what is highly advantageous for one of those countries disastrous for the other. The Hungarian has not inspired the labourer with any interest in his own industry; by sharing the land and the days of the week, he has made an enemy of the man, who should have been his coadjutor. The labour is performed without zeal or intelligence; the master's share, inferior to what it would have been according to the other system, is collected with fear; the peasant's share is so reduced, that he lives in constant penury: and some of the most fertile countries in the world have already been for ages doomed to this state of wretchedness and oppression.

But the legistator's interference, which we claimed for the metayer, has, in some of the countries cultivated by corvées, actually taken place in favour of the vassal, peasant, or serf. In the German provinces of the Austrian monarchy, contracts between the landlord and peasant are, by law, made irrevocable, and most of the corvées have been changed into a fixed and perpetual rent of money, or of fruits in a raw state. By this means, the peasant has acquired a true property in his house and land; only, it continues to be charged with rents, and some feudal services. Still farther to protect the peasantry from being afterwards oppressed or gradually expelled from their properties, by the opulent lords living among them, the law does not allow any noble to buy a vassal's land; or, if he does buy any, he is obliged to sell it, on the same conditions, to some other family of peasants; so that the property of the nobles can never increase, or the agricultural population diminish.

These regulations of the Austrian government in behalf of an order, which, if left to itself, must needs be oppressed, are almost sufficient to redeem the errors of its general system, by this increase of happiness to the subject, and of stability to the system itself. In a country deprived of liberty, where the finances have at all times been wretchedly administered, where wars are eternal—and still disastrous, obstinacy there being always joined with incapacity; the great mass of the population, composed almost wholly of peasant-proprietors living in easy circumstances, have been rendered happy; and this mass of subjects, feeling their own happiness, and dreading every change, have mocked all the projects of revolution or of conquest directed against their country, the government of which is so little able to defend itself.

The system of cultivating land by capitation, could be adopted only among a people scarcely emerged from barbarism. It is, in fact, nearly a modern farm-lease, the parties to which, in fixing the rent, pay no regard to the greater or smaller extent of the ground, to its comparative fertility or barrenness, to the improvements which labour has already made it undergo. Be the nature of these circumstances what it may, each proprietor of a whole Russian province pays thirty roubles yearly to the lord of it. Doubtless when the capitation was imposed, all those circumstances were equal; there was more fertile land for each than each could cultivate, and no part of it had yet been improved by labour.

In free countries, capitation is looked upon as a degrading tax, because it recals the idea of servitude. It was, indeed, originally always accompanied with servitude of the soil. The peasant always depended on the good pleasure of his master; in executing their mutual contract, no law afforded him protection; he was always liable to be ejected, carried off, sold, stript of all the property amassed by his industry; and thus the kind of authority to which he was subject incessantly reminded him, that, whatever he saved, he took from himself to give it to his master; that every effort on his part was useless, every invention dangerous, every improvement contrary to his interest, and finally, that every sort of study but aggravated his wretchedness by more clearly informing him of his condition.

Even in Russia, however, the disinterestedness of some noble families, who for several generations have not changed the capitation, has inspired the peasantry with confidence sufficient to reanimate their industry, to infuse a taste for labour and economy, and sometimes even to permit their realizing very large fortunes, which, however, always depend on the master's good pleasure. But in countries where servitude of the soil has been gradually abolished, the capitation has become a fixed rent; united most frequently to personal services, and sometimes reduced to mere feudal rights, as the system, by degrees, varied from its primitive uniformity. Such was the tenure by villanage in France, by copyhold in England, the origin of nearly all the property possessed by peasants cultivating their own heritages. On the other hand, such contracts helped to produce the notion of farm-leases, which, in the wealthiest countries of Europe, have succeeded every other kind of convention between proprietor and cultivator.

By a farm-lease, the proprietor yields his land, and nothing more, to the cultivator; and demands an invariable rent for it; whilst the farmer undertakes to direct and to execute all the labour by himself; to furnish the cattle, the implements, and the funds of agriculture; to sell his produce, and to pay his taxes. The farmer takes upon him all the cares and all the gains of his agriculture; he treats it as a commercial speculation, from which he expects a profit proportionate to the capital employed in it.

At the time when slavery was abolished, the system of farms could not be immediately established: freedmen could not yet undertake such important engagements, nor were they able to advance the labour of a year, much less that of several years, for putting the farm in a proper condition. The master, on giving them their liberty, would have been obliged to give them also an establishment; to furnish them with cattle, instruments of tillage, seed and food for a year; and after all these advances, the farm would still have been a burdensome concern for the owner, because by his contract he had renounced the profit of good years on condition that his farmer should warrant him against bad years; but the farmer who had nothing could warrant nothing, and the master would have given up his good crops without any return.

The first farmers were mere labourers; they executed most of the agricultural operations with their own hands; they adjusted their enterprises to the strength of their families; and as the proprietor reposed little confidence in their management, he used to regulate their procedure by numerous obligatory clauses; he limited their leases to a few years, and kept them in a continual state of dependence. During the last century, farmers, particularly in England, have risen to rank and importance. Political writers and legislators have uniformly viewed them with a favourable eye; their leases have ceased to be limited in time to a small number of years; and hence farmers have issued from a more elevated class of society. With larger capitals, they have taken farms of a larger size; more extensive knowledge, and a better education have enabled them to treat agriculture as a science. They have applied to it several important discoveries in chemistry and natural history; they have also in some degree united the habits of the merchant with those of the cultivator. The hope of a larger profit has induced them to make larger advances; they have renounced that parsimony which originates in want, and stands in direct opposition to enlightened economy; they have calculated and recorded the result of their operations with greater regularity, and this practice has furnished better opportunities of profiting by their own experience.

On the other hand, farmers from this time have ceased to be labourers; and below them has of course been formed a class of men of toil, who being entrusted with supporting the whole nation by their labour, are the real peasants, the truly essential part of the population. The peasantry, strengthened by the kind of labour most natural to man, are perpetually required for recruiting all the other classes; it is they who must defend the country in a case of need; whom it most concerns us to attach to the soil where they were born; and policy itself would invite every government to render their lot happy, even though humanity did not command it.

When the system of small farms has been compared, as is often done, with that of great farms, it has not been sufficiently considered that the latter, by taking the direction of his labour out of the peasant's hands, reduces him to a condition greatly more unhappy, than almost any other system of cultivation. In truth, hinds performing all the labours of agriculture, under the command of a rich farmer, are not only more dependant than metayers, but even than serfs, who pay their capitation or their service. The latter, whatever vexations they experience, have at least a hope, a property, and a heritage to leave their children. But the hind has no participation in property, nothing to hope from the fertility of the soil or the propitiousness of the season; he plants not for his children; he entrusts not to the ground the labour of his young years to reap the fruit of it with interest in his old age. He lives each week on the wages of the last. Ever exposed to the want of work by derangements in his master's fortune; ever ready to feel the extremes of want, from sickness, accident, or even the approaches of old age, he runs all the risks of ruin without enjoying any of the chances of fortune. Economy in his situation is scarcely probable; but though he should succeed in collecting a little capital, the suppression of all intermediate ranks hinders him from putting it to use. The distance between his lot and that of an extensive farmer, is too great for being passed over; whereas, in the system of cultivation on the small scale, a labourer may succeed, by his little economy, in acquiring a small farm or a small metairie; from this he may pass to a greater, and from that to every thing. The same causes have suppressed all the intermediate stages in other departments of industry. A gulf lies between the day-labourer and every enterprise of manufacture or trade, as well as farming; and the lower classes have now lost that help which sustained them in a former period of civilization. Parish aids, which are secured to the day-labourer, increase his dependence. In such a state of suffering and disquietude, it is not easy to preserve the feeling of human dignity, or the love of freedom; and thus at the highest point of modern civilization, the system of agriculture approximates to that of those corrupt periods of ancient civilization, when the whole labour of the field was performed by slaves.

The state of Ireland, and the convulsions to which that unhappy country is continually exposed, show clearly enough how important it is for the repose and security of the rich themselves, that the agricultural class, which forms the great majority of a nation, should enjoy conveniences, hope, and happiness. The Irish peasants are ready to revolt, and plunge their country into the horrors of civil war; they live each in a miserable hut, on the produce of a few beds of potatoes and the milk of a cow; more unhappy, at the present day, than the cottagers of England, though possessing a small property, of which the latter are destitute. In return for their allotted portion of ground, they merely engage to work by the day, at a fixed wage, on the farm where they live; but their competition with each other has forced them to be satisfied with a wage of the lowest possible kind. A similar competition will act likewise against the English cottagers. There is no equality of strength between the day-labourer, who is starving, and the farmer, who does not even lose the revenue of his ground, by suppressing some of his habitual operations; and hence the result of such a struggle between the two classes, is constantly a sacrifice of the class which is poorer, more numerous, and better entitled to the protection of law.

Rich proprietors generally find that for themselves large farms are more advantageous than small ones. The small farmer rarely employs a capital sufficient even for his little cultivation; himself is always so near to ruin, that he must begin by ruining the ground. And certainly in countries, where the different systems of cultivation are practically set in opposition to each other, it is granted that land is ruined by letting it on lease, and reimproved by cultivating it with servants or metayers. It is not, therefore, small farms, but metairies, which ought to be compared with large farms. Cultivation, on the great scale, spares much time which is lost in the other way; it causes a greater mass of work to be performed in the same time by a given number of men; it tends, above all, to procure from the employment of great capitals the profit formerly procured from the employment of numerous workmen; it introduces the use of expensive instruments, which abridge and facilitate the labour of man. It invents machines, in which the wind, the fall of water, the expansion of steam, are substituted for the power of limbs; it makes animals execute the work formerly executed by men. It hunts the latter from trade to trade, and concludes, by rendering their existence useless. Any saving of human strength is a prodigious advantage, in a colony, where the supernumerary population may always be advantageously employed. Humanity justly solicits the employment of machines to aid the labour of the negroes, who cannot perform what is required of them, and who used to be incessantly recruited by an infamous commerce. But in a country where population is already too abundant, the dismissal of more than half the field-labourers is a serious misfortune, particularly at a time, when a similar improvement in machinery causes the dismissal of more than half the manufacturing population of towns. The nation is nothing else but the union of all the individuals who compose it, and the progress of its wealth is illusory, when obtained at the price of general wretchedness and mortality.

Whilst, in England, the peasantry are hastening to destruction, their condition is improving in France; they are gathering strength, and without abandoning manual labour, they enjoy a kind of affluence; they unfold their minds, and adopt, though slowly, the discoveries of science. But in France, the peasants are mostly proprietors: the number of those who cultivate their own lands prodigiously increased in the Revolution; and to this cause must be attributed the rapid progress which agriculture is making in that country, in spite of a long war and heavy contributions. Perhaps England might partly obtain a similar advantage, if these vast commons were shared among her cottagers, to whom the charm of property would thus be restored.

The most industrious provinces of France are, at this time, experiencing the unlooked-for effects of dividing property among its true cultivators; we mean the distribution of great farms among the contiguous peasantry, by a great number of particular contracts. A large proprietor now rarely gives his farm to be cultivated by a single person; he finds it infinitely more advantageous, at present, to share his domain, among a number of neighbouring peasants, each of whom takes as much land as is requisite to occupy him all the year. No doubt, the peasant will generally sacrifice the land which he farms, to that which is his property; but both those portions are cultivated with the ardour which a direct interest excites in the labourer, and with the intelligence which is developed in him, now that his lord can no longer oppress him. The agricultural classes are as happy as the political circumstances of a country, loved with enthusiasm, permit them to be.

To conclude our review of the systems, by which territorial wealth is incessantly renewed, we ought yet to bestow a moment of attention on the system of *emphyteuses* or perpetual farms, the most suitable of all when government has grants of land to make.

In other systems of cultivation, the agriculturist acquires all the fruit of his annual advances, but he can never be sure of profiting from those irredeemable advances by which a perpetual value is added to land, from drainings, plantations, and breaking up of the soil. Proprietors, of themselves, are seldom enabled to make such advances. If they sell the land, the purchaser, in order to acquire it, must surrender that very capital, with which he might have made those improvements. The lease of *emphyteusis*, or plantation, which is the proper meaning of the word, was thus a very useful invention, as by it the cultivator engaged to break up a desert, on condition of acquiring the *dominium utile* of it for ever, whilst the proprietor reserved for himself an invariable rent to represent the *dominium directum*. No expedient could more happily combine, in the same individual, affection for property, with zeal for cultivation; or more usefully employ in improving land, the capital destined to break it up. Although this kind of lease is known in England under the name of *freehold for many lives*; and though it is even of great importance in this kingdom, as the right of voting in county elections depends upon it, its beneficial influence has chiefly been experienced in Italy, where it is named *livello*. In the latter country, it has restored to the most brilliant state of cultivation whole provinces, which had been allowed to run waste. It cannot, however, become a universal mode of cultivation, because it deprives the direct proprietor of all the enjoyment of property, exposing him to all the inconveniences, with none of the advantages, in the condition of the capitalist; and because the father of a family can never be looked upon as prudent or economical, when he thus alienates his property for ever, without at least retaining the disposal of the price to be received in exchange for it.

For reproducing territorial wealth, it is sufficient, in general, that the use of the ground be transmitted to the industrious man, who may turn it to advantage, whilst the property of it continues with the rich man, who has no longer the same incitements or the same fitness for labour, and who thinks only of enjoyment. The national interest, however, sometimes also requires that property itself shall pass into hands likely to make a better use of it. It is not for themselves alone that the rich elicit the fruits of the earth; it is for the whole nation; and if, by a derangement in their fortune, they suspend the productive power of the country, it concerns the whole nation to put their property under different managers. Personal interest is, indeed, sufficient to bring about this transmission, provided the law offers no obstacle. When a soldier comes to inherit a machine for making stockings, he does not keep it long; in his hands, the machine is useless for himself and the nation; in the hands of a stocking-maker it would be productive, both for the nation and the individual. Both feel this; and a bargain is soon struck. The soldier receives money, which he well knows how to employ; the stocking-maker receives possession of his frame, and production recommences. Most of our European laws respecting immoveable property, are like a law made to hinder the soldier from parting with the frame, of whose use he is ignorant.

The value of land cannot be unfolded, except by employing a capital sufficient to procure the accumulation of that labour which improves it. Hence, it is essential to the very existence of a nation, that its land be always in the hands of those who can devote capital to its cultivation. If it were not in any case allowed to sell a workman's implement, it would not, certainly, at least, be forbidden to make new ones for the use of new workmen; but new lands cannot be made, and so often as the law prevents the alienation of an estate by one that cannot use it, so often does it suspend the most essential of all productions.

The systems of cultivation, which we have now glanced over in review, certainly cause the earth to produce, by the hands of temporary cultivators, when the permanent advances have been made; but they absolutely discourage such cultivators from making those permanent advances which, as they give a perpetual value to property, cannot be laid out except by those with whom that property is destined to continue. Legislators in general, altogether occupied with preventing the alienation of immoveables, and preserving great fortunes in great families, have dreaded lest such an alienation might clandestinely be brought about by a lease, for a long term, and without return. They have eagerly attempted to defend the rights of proprietors against proprietors themselves; they have guided that class of people by forfeits and resolutory clauses; they have fixed upon a short term for farm leases; they seem continually repeating to the cultivator: "This land, on which you work, is not yours; acquire not too much affection for it; make no advances which you might run the risk of losing; improve the present moment, if you can, but think not of the future; above all, beware of labouring for posterity."

Besides, independently of legislative errors, it belongs to the very nature of a farm lease never to allow the farmer to take as much interest in the land as its proprietor. It is enough, that this lease must have an end, to induce the farmer, as this end approaches, to care less about his fields, and to cease laying out money for improving them. The metayer, with smaller power, at least never fears to improve the land committed to him as much as possible; because the conditions of his lease are invariable, and he is never dismissed except for bad behaviour. The farmer, again, is liable to be dismissed directly in consequence of his good management. The more he has improved his farm, the more will his landlord, at renewing the lease, be disposed to require an augmentation of rent; and, besides, as part of the advances laid out by the cultivator on the ground create a perpetual value, it is neither just nor natural that they should be made by one whose interest is merely temporary. The farmer will carefully attend to the fields and meadows, which, in a few years, are to give him back all his advances; but he will plant few orchards; few high forests in the North; few vineyards in the South; he will make few canals for navigation, irrigation, or draining; he will transport little soil from one place to another; he will clear little ground; he will execute, in short, few of those works which are most conducive to the public interest, because they found the wealth of posterity.

None of those labours, on which the increase of the whole national subsistence depends, can be undertaken save by a proprietor rich in moveable capital. It is not the preservation of great fortunes that concerns the nation, but the union of territorial fortunes with circulating ones. The fields do not flourish in the hands of those who have already too much wealth to watch over them, but in the hands of those who have enough of money to bring them into value. Territorial legislation ought, therefore, without ceasing, to strive that moveable capital be united with fixed; property, which we call personal, with property which we call real. Legislation over almost all the world has striven to do quite the contrary.

And first, it were always for the national advantage, and favourable to the increase of its production, that the proprietor, whenever his fortune is embarrassed, should sell his property instead of borrowing on it; yet, on the contrary, facilities have been held out to him for borrowing rather than for sale. A particular system of law has been created for territorial debts; marked differences have been established between real and personal property; the rank of creditors on land has been regulated according to their date, whilst an absolute equality prevails among creditors of all dates, who claim only on moveable property. And thus thousands of law-suits have been created, interminable difficulties have been started; and the time is almost come when half the lands of Europe are possessed by people who, far from possessing the power to dispose of a capital that might increase their productiveness, on the contrary, are debtors by a pretty large capital which they cannot extract from these funds. Hence those embarrassed proprietors have incessantly had recourse to ruinous expedients, not to put money on their land, but to take it off; to borrow of their farmers, to diminish the funds of cultivation, to sell their woods, and deteriorate their estates. If the law had given no preference to territorial creditors; if, on the other hand, it had given as much facility to a creditor for selling an immoveable property, as for making seizure of a moveable one; especially if, in protecting personal liberty, sacrificed too slightly, it had permitted lands to be sold as often as it now permits the debtor to be put in prison—most old debts would be extinguished, and those immoveable possessions, which ought to support the nation, would be in the hands of such as could force them, by capital and labour, to furnish the means of subsistence.

But the props lent to the pride of family by entails, *fidei-commissa*, primogenitures, and the laws invented to hinder families in a ruinous condition from selling their property, have still farther impeded the development of agriculture and industry. The legislator aimed at fixing fortune in great families: he has fixed beggary and want in them. On the pretext of securing the patrimony of children, he has forbidden the heir of entail to sell or borrow with a sufficient security to his creditors; but he could not hinder him from going to ruin, and overwhelming himself with clamorous debts. In that case, even the care of his honour, the feeling of justice, and his own security, oblige him to employ all the resources of his mind, all his industry, in destroying his patrimony, that he may obtain the disposal of what law has reserved to his heir. Whatever produce he can detach from the ground without replacing it, whatever advance he can dispense with laying out, is in his eyes just so much profit; and Europe has come to see the proprietors of noble estates, almost everywhere, the enemies of their property. At the same time, if the legislator's object was the preservation of families, he has failed in this object; because entails condemn all the sons of a rich family to idleness; the elder out of pride, the younger out of inability. The system has proscribed all from industry, the sole mean of increasing property; whilst it leaves them subject to all human chances, which never cease to attack whatever is ancient, and which must always in the end destroy whatever opulence is not renewed.

CHAP. IV.

OF COMMERCIAL WEALTH.

Of commercial wealth.

By labour man drew his first wealth from the earth, but scarcely had he satisfied his primitive wants, when desire made him conceive other enjoyments not to be obtained without the aid of his fellows. Exchanges began. They extended to whatever had any value, to whatever could produce any; they comprised mutual services and labour, no less than the fruit of labour; and gave room to the formation and increase of a new kind of wealth, which was no longer measured by the wants of him who produced it, but by the wants of all those with whom he might transact exchanges,—with whom he might carry on commerce; and hence we have named it *commercial wealth*.

The solitary man was used to labour for his own wants, and his consumption was the measure of his production; he fitted out a place to produce him provisions for a year, for two years perhaps; but afterwards he did not indefinitely augment it. It was enough to renew the process so as to maintain himself in the same condition; and, if he had time to spare, he laboured at acquiring some new enjoyment, at satisfying some other fancy. Society has never done any thing by commerce, except sharing among all its members what the isolated man would have prepared solely for himself. Each labours, in like manner, to provide for all during a year, two years, or more; each labours afterwards to keep up this provision, according as consumption destroys a part of it; and since the division of labour and the improvement of arts allow more and more work to be done, each, perceiving that he has already provided for the re-production of what has been consumed, studies to awaken new tastes and new fancies which he may satisfy.

But when a man laboured for himself alone, he never dreamt of those fancies, till he had provided for his wants; his time was his revenue; his time formed also his whole means of production. There was no room to fear, that the one would not be exactly proportioned to the other; that he would ever work to satisfy an inclination which he did not feel, or which he valued less than a want. But when trade was introduced, and each no longer laboured for himself, but for an unknown person, the different proportions subsisting between the desire and what could satisfy it, between the labour and the revenue, between production and consumption, were no longer equally certain; they were independent of each other, and every workman was obliged to regulate his conduct by guessing on a subject, concerning which the most skilful had nothing but conjectural information.

The isolated man's knowledge of his own means and his own wants required to be replaced by a knowledge of the market, for which the social man was labouring; of its demands and its extent.

The number of consumers, their tastes, the extent of their consumption and their income, regulate the market for which every producer labours. Each of these four elements is variable, independently of the rest, and each of their variations accelerates or retards the sale. The number of consumers may decrease, not only by sickness or war, but also by obstacles which policy may place in the way of their communication, or by the avarice of new sellers. Their tastes may be changed by fashion: an extraordinary consumption of one kind of merchandise, brought about by some public calamity, may have reduced them to be frugal in all the rest; and finally, their income may diminish without a diminution of their number, and with the same wants the same means of satisfying them may no longer exist. Such revolutions in the market are difficult to know with precision, difficult to calculate; and their obscurity is greater for each individual producer, because he but imperfectly knows the number and means of his rivals, the merchants, who are to sell in competition with him. But one single observation serves him instead of all others: he compares his price with that of the buyer, and this comparison, according to the profit or the loss which it offers him, is a warning to increase or to diminish his production for the following year.

The producer establishes his price according to what the merchandise has cost, including his profit, which ought to be proportional to what might be obtained in any other kind of industry. The price must be sufficient to repay the workmen's wages, the rent of the land, or the interest on the fixed capitals employed in production, the raw materials wrought by him, with all the expences of transport, and all the advances of money. When all these reimbursements, calculated at the mean rate of the country, are themselves repaid by the last purchaser, the production may continue on the same footing. If the profits rise above the mean rate, the producer will extend his enterprises; he will employ new hands and fresh capital, and, striving to benefit by this extraordinary profit, he will soon reduce it to the common level. If the buyer, on the other hand, pays a price too low for compensating all the producer's reimbursements, the latter will of course seek to reduce his production, but this change will not be so easy as the other. The workmen employed by him, rather than abandon what gains their bread, consent to work at a lower price, for less even than the necessaries of life. Fixed capitals, moreover, cannot be put to another use; he will content himself with a smaller profit, and continue to work with them till they produce next to nothing. Lastly, the manufacturer himself must live by his industry, and never willingly abandons it: he is ever disposed to attribute the decline of his last year's trade to accidental causes; and the less he has gained, the less is he willing to retire from business. Thus production continues almost always longer than demand, unless the manufacturer has of his own accord renounced his business to attempt a new one.

The buyer's price, on the other hand, is fixed by competition. He does not inquire what the article costs, but what are the terms on which he may obtain another to serve in its stead; he addresses himself to various merchants, who offer him the same commodity, and bargains with him who will sell cheapest; or else he considers which will suit him best among several articles of a different nature, but capable of being substituted for each other. As each is occupied solely with his own private interest, each tends to the same object; all the buyers, on one hand, all the sellers, on the other, act as if in concert: the sums asked, and the sums offered, are brought to an equilibrium, and the mean price is established.

The seller's price should enable him to reproduce the article sold, with a profit, under the same condition, in the same place. His market, therefore, extends to every country where the mean price established by commerce is not smaller than his. His production is not limited by the consumption of neighbours or countrymen; it is regulated by the whole number of those who, whatever country they inhabit, find an advantage in purchasing his goods, or for whom his producing price is not superior to the buying price. It is this which properly constitutes the extent of market.

As the division of labour incessantly augments its productive powers, and the increase of capitals daily obliges the merchant to seek new employment for industry, and try new manufactures, the producer feels no interest more pressing than that of extending his market. If he cannot find new places of sale, it will neither suit him to enlarge his manufactory, when his capital has been increased by saving, nor to improve his fabrication by performing more work with the same machinery, or the same number of hands. The whole progress of his fortune depends on the progress of his sale.[*]

Among the causes which augment this sale, the first is the discovery of such an economy in labour as may enable the manufacturer to sell cheaper than his brethren, and to get possession of their custom: he will sell more, but they will sell less. The consumers will make a slight saving; yet, if both are subjects of the same state, the difference in regard to the national interest will not be great. The distress of those producers, who have lost their custom, and who probably will lose a considerable part of their capital by selling their wares too cheap, and abandoning their former machinery, will perhaps counterbalance the profit of purchasers.

As policy is wont to comprise the obligation of social duties within the circle of our countrymen, the mutual rivalship of foreign producers has more openly displayed itself. They have striven to exclude each other from the markets, where they came in competition, by selling at a cheaper rate. Every national discovery, which allows the producers of one country to sell cheaper than those of other countries, inevitably increases the former's production at the latter's expence; and the profit of this saving is shared between producers who extend their market, and consumers who provide for their wants at a smaller expence. Yet if a single manufacturer has succeeded in making this saving, which extends his market; or if the exclusive use of it is secured to him by patent, his countrymen, also manufacturers, against whom he has made this successful competition, must support all the loss of it, whilst himself and the foreign consumer share all the profit. In an age, when communication among different countries is easy, when all the sciences are applied to all the arts, discoveries are soon divined and copied, and a nation cannot long retain an advantage in manufacturing which it owes but to a secret; so that the market, extended for a moment by a fall in the price, is very soon shut up; and if the general consumption is not increased, the production is not so either.

Sale is extended also, and in a more lasting manner, when the cheapness of the thing produced brings it within the reach of a new class of consumers; a very sensible diminution of the price may often produce this effect. Thus glass windows were at one time confined to palaces; they are found at the present time in the meanest huts. Consumption is in that case truly increased; each nation gains doubly by it; manufacturers have extended their labour; the poor have acquired a new enjoyment.

The increase of population, and of national wealth, contributes to extend the market, in a manner still more advantageous. Yet every conceivable increase of population and of wealth does not of necessity extend the market; it is only such an increase as attends the increased comforts of the most numerous class. When cultivation on the great scale has succeeded cultivation on the small, more capital is perhaps absorbed by land and reproduced by it; more wealth than formerly may be diffused among the whole mass of agriculturists, but the consumption of one rich farmer's family, united to that of fifty families of miserable hinds, is not so valuable for the nation, as that of fifty families of peasants, no one of which was rich, but none deprived of an honest competence. So also in towns, the consumption of a manufacturer worth a million, under whose orders are employed a thousand workmen reduced to the bare necessaries of life, is not so advantageous for the nation, as that of a hundred manufacturers far less rich, who employ each but ten workmen far less poor. It is very true, that ten thousand pounds of income, whether they belong to a single man, or to a hundred, are all equally destined for consumption, but this consumption is not of the same nature. A man, however rich, cannot employ for his use an infinitely greater number of articles than a poor man, but he employs articles infinitely better; he requires work far better finished, materials far more precious, and brought from a far greater distance. It is he who especially encourages the perfection of certain workmen, that finish a small number of objects with extreme skill; it is he who pays them an exorbitant wage. It is he also that especially rewards such workmen as we have named unproductive, because they procure for him nothing but fugitive enjoyments, which can never by accumulation form part of the national wealth; and whilst the effect of increasing capital is generally to concentrate labour in very large manufactories, the effect of great opulence is almost entirely to exclude the produce of those large manufactories from the consumption of the opulent man. The diffusion of wealth, therefore, still more than its accumulation, truly constitutes national prosperity, because it keeps up the kind of consumption most favourable for national reproduction.

The manufacturer's market may, in the last place, be extended, by what forms the noblest wish of a statesman, the progress of civilization, comfort, security, and happiness, among barbarous nations. Europe has arrived at such a point, that in all its parts there is to be found an industry, a quantity of fabrication, superior to its wants; but if false policy did not incessantly induce us to arrest the progress of civilization among our neighbours; if Egypt had been left in hands of a people requiring the arts of Europe; if Turkey were extricated from the oppression under which it groans; if our victories over the inhabitants of Barbary had been profitably employed in giving back the coasts of Africa to social life; if Spain had not again been yielded to a despotism which destroys and ruins her population; if the independents of America were protected, so that they might be allowed to enjoy the advantages which nature offers them; if the Hindoos, subject to Europe, were amalgamated with Europeans; if Franks were encouraged to settle among them, in place of being repelled,—consumption would increase in these different countries, rapidly enough to employ all this superabundant labour, which Europe at present knows not how to dispose of, and to terminate this distress in which the poor are plunged.

The more superior the buyer's price is to the seller's, the more profit does trade give to be shared among the trader and all those whom he employs in the transport and distribution of his goods; the manufacturer, and all those whom he employs in the production of them. Hence one of the great and constant objects of governments has been, to increase this difference, that their manufacturers might be enabled to produce cheap, and so find many buyers, and to sell dear to such as could not buy elsewhere, and so gain a large profit. The progress of society generally enables civilized nations to produce cheaper; the almost ever injudicious protection of government often gives them means of selling dearer.

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[*] Since all the talent of the merchant essentially tends to increase his sale; since the main object of all mercantile policy is the national sale; since every commercial calamity is explained by the diminution of sale, what is to be thought of that doctrine which reduces political science to the forming of a greater and greater number of producers more and more active, and which supposes that, by indefinitely augmenting production, sale will also be indefinitely augmented?

The low price of workmanship is the first cause of manufacturing profit; but this low price is never a national advantage, except when it is produced by superiority of climate, greater fertility of soil, or abundance of provision. On the contrary, when it arises from the difficulty of communication which prevents cultivators from reaping all the profit of their wares, it can only be regarded as a private advantage, acquired at the expence of the national advantage. When the low price of workmanship arises from the poverty of day-labourers, forced by competition to content themselves with what is necessary, or less than necessary for life; though commerce may profit by the circumstance, it is nothing better than a national calamity.

Abundance of capital, and the consequence of this, a low price of interest, likewise doubly contribute to diminish the price of production. With more capital, the manufacturer and merchant transact their purchases and sales at a more favourable moment; they are not pressed by either operation, or compelled to provide for the present by a sacrifice of future advantage. Executing all kinds of labour more on the great scale, they save time, and all those incidental charges, which are the same for a great and for a small sum. But as to the saving made by the merchant on the interest of money, it is made at the expence of a particular class, deriving their revenue from trade; it does not enrich the nation any more than the diminution of wages enriched it; it only gives to one what it takes from another.

The increasing division of labour forms, as we have seen, the chief cause of increase in its productive powers; each makes better what he is constantly engaged in making, and when at length his whole labour is reduced to the simplest operation, he comes to perform it with such ease and rapidity, that the eye cannot make us comprehend how the address of man should arrive at such precision and promptitude. Often also this division leads to the discovery, that as the workman is now worth nothing more than a machine, a machine may in fact supply his place. Several important inventions in mechanics applied to the arts, have thus sprung from the division of labour; but by the influence of this division man has lost in intelligence all that he has gained in the power of producing wealth.

It is by the variety of its operations that our soul is unfolded; it is to procure citizens that a nation wishes to have men, not to procure machines fit for operations a little more complicated than those performed by fire or water. The division of labour has conferred a value on operations so simple, that children, from the tenderest age, are capable of executing them; and children, before having developed any of their faculties, before having experienced any enjoyment of life, are accordingly condemned to put a wheel in motion, to turn a spindle, to empty a bobbin. More lace, more pins, more threads, and cloth of cotton or silk, are the fruit of this great division of labour; but how dearly have we purchased them, if it is by this moral sacrifice of so many millions of human beings.

The employment of machinery in place of men, has contributed generally to lessen the price of production. At the renovation of arts and civilization, there was so much work to be done, and so few hands to do it; oppression had so far reduced the poor class; there remained so much uncultivated land in the country, so many ill-supplied trades in towns; and sovereigns required so many soldiers for war, that it seemed workmanship could never be economised enough, since an artisan, sent away from one trade, would always find ten others ready to receive him. Circumstances are not now the same; our labour is scarcely sufficient for the labourers. We shall endeavour, in another place, to explain the cause of this fact; in the mean time, surely none will maintain that it can be advantageous to substitute a machine for a man, if this man cannot find work elsewhere; or that it is not better to have the population composed of citizens than of steam-engines, even though the cotton cloth of the first should be a little dearer than that of the second.

The application of science to art is not limited to the invention of machinery; its result is the discovery of raw materials, dyeing ingredients, preservative methods more sure and economical. It has produced better work at a cheaper rate; it has protected the health of labourers, as well as their produce; and its effect in augmenting wealth has almost always been beneficial to humanity.

Finally, the different quarters of the globe possess advantages of climate, soil, exposure, which not only render the subsistence of man more easy or cheaper, but also place within his reach certain raw materials, which other nations cannot procure at the same price. Hence results in their favour a kind of monopoly, which they exercise over others, and of which it is rare that they do not take advantage. There is also in some degree, a natural advantage in the superiority of the people itself in certain climates; the bounty of nature seems to have reserved for those who inhabit them a superiority of industry, intelligence, strength of body, or constancy in labour, which do not even require to be developed by education. But other qualities, other virtues, which appear to contribute more effectually still to the increase of riches, as well as to the happiness of society—the love of order, economy, sobriety, justice—are almost always the work of public institutions. Religion, education, government, and principles of honour, change the nature of men; and as they make good or bad citizens of them, they advance or retard their approach to the object proposed by political economy.

But governments have rarely been satisfied with such advantages as the trade of their states might owe to nature, or to the progress of society. They have attempted to favour the increase of commercial wealth; and their different expedients have most frequently tended to assist the merchant in selling dear, rather than producing cheap. With the latter object, however, we have seen the exportation of raw materials prohibited, the rate of interest fixed, and laws enacted to lower the wages of labour.

These three expedients had a common fault, that of sacrificing one class to another, and founding the profit of trade, not on the advantage of consumers, but on the loss of cultivators, capitalists, or workmen;

so that its profits, far from being an increase of the national wealth, were a displacement of it. The raw materials on which the arts operate, are all, or nearly all, produced by agriculture, or at least drawn from the ground; hence they form part of the proprietor's or the cultivator's wealth. If some advantage did not arise from exporting them, nobody would think of forbidding them to be exported. This prohibition indicates sufficiently, that the persons who produced them were better paid, or gained more by selling them to strangers; and the law restricts their market, in opposition to the principle which we have pointed out above, as the foundation of commercial interest; the principle of obtaining for each article of produce the highest possible price. From such prohibitions to export, there must result, first, a diminution in the price of the raw material, for its price is no longer kept up by free trade; secondly, a diminution in the quantity produced, because it is regulated by the interior demand; and, lastly, a deterioration of its quality, for a calling which is ill rewarded is likewise ill attended to. This, therefore, is one of the most injudicious means of favouring trade; and at the same time, it sacrifices the income of all those who contribute to produce the raw material. Whatever trade gains from them, cannot be considered as adding aught to the national revenue.

To fix the interest of money, or to suppress it altogether, as some legislators have attempted, has generally been the consequence of religious prejudices and of mad attempts to adapt the Jewish legislation to modern Europe. The effect of these laws, so opposite to the general interest, has always been either to force contractors to envelop themselves in a secrecy which they must require payment for, and may use as a snare for the unsuspiciousness of others; or else to force capitalists to employ, in other countries, that capital which they could not lend in their own neighbourhood, with the same safety and advantage. But the very end which legislators proposed was bad; a diminution in the rent of the national capital, is a national evil; it is a loss of part of the revenue. Most frequently, indeed, this evil is the sign of an advantage greatly superior to it, namely, the increase of capitals themselves; but, in forcibly producing the sign, we cannot at all forcibly produce the thing, any more than by turning round the pointers of a watch we can alter the flight of time.

Attempts on the part of government to fix the rate of wages, to make workmen labour at a lower price, are ever the most impolitic and the most unjust of these partial laws. If government should propose, as an object, the advantage of any one class in the nation at the expence of the rest, this class ought to be precisely the class of day-labourers. They are more numerous than any other; and to secure their happiness is to make the greatest portion of the nation happy. They have fewer enjoyments than any other; they obtain less advantage than any other from the constitution of society; they produce wealth, and themselves obtain scarcely any share of it. Obliged to struggle for subsistence with their employers, they are not a match for them in strength. Masters and workmen are indeed mutually necessary to each other; but the necessity weighs daily on the workman; it allows respite to his master. The first must work that he may live, the second may wait and live for a time without employing workmen. Hence in the riots and combinations of workmen for obtaining an increase of wages, their conduct is often violent and tumultuous, and often merits the chastisement which it never fails to receive; but scarcely an instance exists, where justice has not been upon their side.

The expedients invented by governments to assist their merchants in selling dear, are numerous. Some tend to diminish the number of producers in a market of given extent, and therefore to force buyers to raise their price; such are apprenticeships, corporations, monopolies granted to companies, prohibitions to import, exclusive governments of colonies, and favours obtained by treaties of commerce; others, such as bounties and drawbacks, are destined really to extend the market; though by securing to the manufacturers a profit at the government's expence, not the consumer's.

The regulations of apprenticeships and the statutes of corporations, were destined, it is said, to hinder ignorant workmen from following any trade which they did not yet understand; they were forced to devote a determinate number of years to learn it, and afterwards to gain admission into a body which always made obstacles to the entrance of new comers, and limited their number. The pretence of thus watching over the training of artisans cannot be made good. It has often been proved, that rivalship alone gives that training, whilst a long apprenticeship blunts the mind and discourages industry; but the true, though secret object, to diminish the number of those exercising a trade, was attained. The corporate body exercised a kind of monopoly against the consumer; it took care at all times to keep the supply below the demand. The merchant doubtless gained more; but he gained on a smaller production. There was less work done, less increase of capital, less population supported; and as to the merchant's extraordinary profit, it was compensated by an equal loss to the consumer, who was obliged to pay, not according to his own advantage or convenience, but according to the arbitrary caprice of a corporation which gave laws to him.

In all trading countries, a more or less exclusive monopoly has been granted, on certain occasions, to some associations of merchants, under the name of Trading Companies. The avowed motive for sacrificing the whole class to this privileged number was the particular nature of the trade thus subjected to a monopoly, which trade it was said could not be supported except by very extensive funds; but governments had often a secret motive besides; and this was, the sum of money for which the merchants bought their privilege. A company's monopoly has never failed to heighten the price for the consumer, to diminish production and consumption, to give the national capital a false direction; sometimes by attracting it prematurely to a branch of trade which was not yet suitable, sometimes by repelling it when fruitlessly seeking an employment. But although companies obtained the desired privilege of buying cheap and selling dear, by nature they are so ill suited for economy and trading speculations, that although amazingly rich, and sometimes sovereigns of countries, these companies, their administrators having no immediate interest in the prosperity of their trust, have almost all been robbed, and very few of them have not ended in bankruptcy.

These different expedients for the protection of commerce, are now generally decried, though almost all governments yet agree in repelling from their states the produce of foreign manufactories, or at least in loading it with heavy duties, to give the national produce an advantage. The prohibitive system of custom-house duties plainly gives to a growing manufactory an advantage equivalent to the largest bounty. Perhaps this manufactory scarcely produces the hundredth part of what the nation consumes of such commodities; but the hundred purchasers must compete with each other to obtain the one seller's preference, and the ninety-nine rejected by him will be compelled to obtain goods by smuggling. In this case, the nation's loss will be as a hundred; its gain as one. Whatever advantage may arise from giving a new manufacture to a nation, certainly there are few which deserve such a sacrifice, and even these might always be set agoing by less expensive means. Besides, we must also take into account the weighty inconveniences of establishing the vexatious system of duties, of covering the frontiers with an army of custom-house officers, and with another not less dangerous army of smugglers, and thus of training the subjects to disobedience. We must remember, above all, that it is not the interest of a nation to produce every thing indifferently; that it ought to confine its efforts to such goods or commodities as it can manufacture at the cheapest rate; or to such as, whatever price they cost, are essential to its safety. It ought to be recollected that each merchant knows his own business better than government can do; that the whole nation's productive power is limited; that in a given time, it has but a given number of hands, and a given quantity of capital; that by forcing it to enter upon a kind of work which it did not previously execute, we almost always at the same time force it to abandon a kind of work which it did execute; whilst the most probable result of such a change is the abandonment of a more lucrative manufacture for another which is less so, and which personal interest had designedly overlooked.

If the prohibitive system gives a very powerful, though very expensive encouragement to rising manufactures, it can offer, in regard to such, no advantage to those which are already prosperous; the sacrifice at least which it imposes on consumers, is entirely useless. If the manufacture was destined for exportation, government, by granting a monopoly of the interior market, causes it to abandon its ancient habits to assume others which probably are less advantageous. Every manufacture destined for exportation gives proof of not fearing the competition of foreigners. From the moment that it can support competition abroad, notwithstanding the expence of transport, it has still less reason to dread this competition in the very place of production. Thus nothing is more common than to see goods prohibited which never could have been imported with advantage, and which gained credit solely by being so prohibited.

By the prohibitive system, governments had proposed to increase the number and productive powers of their manufactures. It is doubtful if they rightly knew the price they paid for this advantage, and the prodigious sacrifices they imposed on consumers, their subjects, to bring into existence an unborn class of producers; but they succeeded much more rapidly even than speculators on political economy expected. For a time they excited the bitterest complaints on the part of consumers; but even these complaints ceased afterwards, because sacrifices in fact had also ceased, and manufactures so powerfully encouraged, had soon provided with profusion for the national wants. But this emulation of all governments to establish manufactures everywhere, has produced two strange and unexpected effects on the commercial system of Europe; one is the disproportionate increase of production without any relation to consumption; the other is the effort of each nation to live isolated, to suffice for itself, and refuse every kind of foreign trade.

Before governments had been seized with this manufacturing ardour, the establishment of a new manufacture had always to struggle with a crowd of national habits and prejudices, which form as it were the *vis inertiæ* of the human mind. To overcome this force, it was necessary to offer speculators a very manifest advantage; hence a new species of industry could scarcely arise without a distinct previous demand, and the market was always found, before the manufacture destined to occupy it. Governments, in their zeal, have not proceeded upon this principle; they have ordered stockings and hats beforehand, reckoning that legs and heads would be found afterwards. They have seen their people well and economically clothed by strangers, and yet have caused them to produce clothes in the country itself. During war, this new production was not capable of being too exactly appreciated; but when peace came, it was found that all things had been made in double quantity; and the readier the mutual communication of states had become, the more embarrassed were they to dispose of all their works executed without orders.

Consumers, who at the beginning had been satisfied, afterwards found themselves called to unexpected gains, because merchants, eager to recover their funds, were forced to sell a very great quantity of goods with loss. Manufacturers gave the signal for these sacrifices; resigning themselves to a cruel loss of their capital, they induced extensive merchants to furnish themselves with goods beyond their custom or ability, in order to profit by what appeared a good opportunity. Several of the latter have been forced to experience a similar loss, before their excessive supply could be introduced to the shops of retail dealers; and these again before they could make them be accepted by consumers. A universal embarrassment was felt by manufacturers, merchants, and retailers; and this was followed by the annihilation of the capital destined to support industry. The fruit of long saving and long labour was lost in a year. Consumers have gained certainly, but their gain is scarcely perceptible even to themselves. By laying up a stock of goods for several years to profit by their cheapness, they have also included themselves in the general embarrassment, and still farther retarded the period when the balance can be re-established between consumption and production.

According to the former organization of Europe, all states did not make pretences to all kinds of industry. Some had attached themselves to agriculture, others to navigation, others to manufactures; and the condition of these latter, even in prosperous times, could not have appeared so worthy of envy as to demand prodigious efforts to attain it. A miserable and degraded population almost always produced these rich stuffs; these elegant ornaments, this furniture which it was never destined to enjoy; and if the men who directed these unhappy workmen sometimes raised immense fortunes, those fortunes were as frequently destroyed. The development of nations proceeds naturally in all directions; it is scarcely ever prudent to obstruct it, but it is no less dangerous to hasten it; and the governments of Europe, by having on all hands attempted to force nations, are at the present day loaded with a population, which they have created by requiring superfluous labour, and which they know not how to save from the horrors of famine.

The existence of this manufacturing population, and the duty of providing for its wants, have constrained governments to alter the aim of their legislation. Formerly, in the real spirit of the mercantile system, they encouraged manufactures, in order to sell much to foreigners, and grow rich at their expence; now, perceiving that a prohibitive system is everywhere adopted, or like to be adopted, they cannot any longer count on the custom of strangers, and therefore study to find in their own kingdom consumers for their own workmen; in other words, to become isolated and sufficient for themselves. The system of policy at present, more or less strictly followed by all the nations of Europe, destroys all the advantage of commerce; it hinders each nation from profiting by the superiorities due to its climate, to its soil, to its situation, to the peculiar character of its people; it arms man against man, and breaks the tie which was destined to sooth national prejudices, and accelerate the civilization of the world.

According to the natural progress of increasing wealth, when capitals are yet inconsiderable, it is certainly desirable to direct them rather to some neighbouring branch of trade, than to one which is very remote; and as the trade of exportation and importation gives foreigners one-half of its profit, and the natives another, a country which has little capital may desire to employ it entirely in the trade of its interior, or for its own use; and the more so, because if the market is near the producer, the same capital will be several times renewed in a given period, whilst another capital, destined for a foreign market, will scarcely accomplish a single renewal. But the capitalist's interest will always direct him with certainty, in such cases, to do what suits the country best; because his profit is proportioned to the need there is of him, and consequently to the direction in which the public demand carries him.

Besides, nations on reckoning up their produce and their wants, almost constantly forget that neighbouring foreigners are much more convenient and more advantageous producers and consumers than distant countrymen. The relation of markets on the two banks of the Rhine is much more important, both for the German and the French merchant, than the relation of markets between the Palatinate and Brandenburgh is for the former, or between Alsace and Provence for the latter.

The ardour, with which all governments have excited every species of production, by means of their restrictive system, has brought about such a disproportion between labour and demand, that perhaps it has become necessary for every state to think first, not of the comfort, but of the existence of its subjects, and to maintain those barriers which have been so imprudently erected. An important part of the population might perhaps be cut off by penury in the course of a few years; and it is reasonable, that each state should seek to preserve itself and those depending on it from such a calamity. Yet we cannot without pain behold the riveting of this anti-social system, and the abandonment of that ancient spirit of commerce, which triumphed over barbarism, and taught hostile hordes to know and esteem each other.

Governments, after having attempted to give the national producers a monopoly in their own country, have sometimes endeavoured to procure them a similar advantage in foreign countries, by treaties of commerce. Such pactions, always subordinate to policy, granted to a favoured nation an exemption from some part of the duties required from others, on consideration of some reciprocal advantage. It cannot be doubted that such an exemption was advantageous to the nation, in whose favour it was granted; but, on the other hand, it was just as disadvantageous to the nation granting it; and when a treaty of commerce bore a concession of mutual exemption, each state should have discovered, that a monopoly granted to its producers was too dearly purchased, by a monopoly granted to foreigners against its consumers; and the more so, as there existed no kind of relation between the two favoured branches of trade. Some show of reason may be discovered, why the consumers of cloth should be taxed, for the advantage of cloth manufacturers; but there is no shadow of reason why the consumers of wine in England should experience a loss, in compensation for an advantage to the sellers of goods in Portugal.

No treaty of commerce can fully satisfy the greediness of merchants desiring a monopoly; and therefore governments invented the fantastic expedient of creating in a colony a nation expressly to be purchasers from their merchants. The colonists were prohibited from establishing any manufacture at home, that so they might be more dependent on the mother country. They were carefully prevented from following any species of foreign trade; they were subjected to regulations the most vexatious, and contrary to their own interests; not for the mother country's good, but for the good of a small number of merchants. The infinite advantages attached to a new country, where every kind of labour is profitable, because every thing is yet to do, enabled colonies to prosper, although they were continually sacrificed. As their raw produce was fit for a distant trade, they had it in their power to support a most unequal exchange, in which nothing was taken from them that the buyer could procure at home; but their rapid increase itself bears witness against the system which has founded them; they have prospered by a system diametrically opposite to that followed by the mother country. The exportation of all raw produce, the importation of all wrought produce, have been encouraged in colonies, and have presented to such as believe in the existence, and calculate the state of a commercial balance, a result as disadvantageous for themselves as it was advantageous for the mother country. Doubtless their oppression gave the latter all the profits of a monopoly; yet in a very circumscribed market; whilst the free trade of all Europe, with all its colonies, would have been more advantageous for both, by infinitely extending the market of the one, and accelerating the progress of the other. What justice and policy should have taught, force will obtain, and the colonial system cannot long continue.

Governments, in the last place, to favour commerce, have granted it bounties and drawbacks. A bounty is a reward which the state decrees to the manufacturer on account of his goods, which comes to him in the shape of profit. A drawback is a restitution of all the taxes, which a piece of goods had paid, granted to it at the moment of its exportation. A drawback is perfectly just and reasonable. It leaves the national producer, in the foreign market, on a footing of equality with all his rivals, whilst, if beforehand he had paid a tax in his own country, he could not have sustained the competition. Bounties are the strangest encouragements which a government can give. They may be justified when granted for the fabrication of an article, the production of which it is necessary to procure at any price: but when granted on exported goods, as often happens, government pays merchants at the expence of its own subjects, that foreigners may buy cheaper of them.

Thus nearly all the favours, which governments confer on trade and manufactures, are contrary even to sound policy or justice; and, judging of them by the law of profit and loss, we should infer that all this attention bestowed by government on trade had done more ill than good. But political economy is in great part a moral science. After having calculated the interests of men, it ought also to foresee what will act upon their passions. Ruled as they are by self-interest, pointing out their advantage will not be sufficient to determine their pursuit of it. Nations have sometimes need of being shaken, as it were, to be roused from their torpor. The small weight which would suffice to incline the balance with a calculating people, is not sufficient when that balance is rusted by prejudice and long continued habits. In such a case, a skilful administration must occasionally submit to allow a real and calculable loss, in order to destroy an old custom, or change a destructive prepossession. When rooted prejudices have abandoned to disrespect every useful and industrious profession; when a nation thinks there can be no dignity except in noble indolence; when even men of science themselves, carried away by public opinion, blush at the useful applications made of their discoveries, and in such applications see nothing but what they call the *cookery* of their sciences; it perhaps becomes necessary to grant favours altogether extraordinary to the industry which it is necessary to create, to fix incessantly the thoughts of a too lively people on the career of fortune which lies before them, intimately to connect the discoveries of science with those of art, and to excite the ambition of those, who have always lived in idleness, by fortunes so brilliant as at length to make them think of what may be accomplished by their wealth and their activity.

It is true, the mercantile capital of a nation is limited in a given time; and those who dispose of it, always desiring to put it out to the greatest advantage, have no need of any new stimulant to augment it, or turn it into the channels where it best produces profit. But all the capital of a nation is not mercantile. Inclination to idleness, which public institutions have fostered among certain nations, not only binds men, but also fetters fortunes. The same indolence, which makes those people lose their time, makes them also lose their money. The annual revenue of territorial fortunes forms of itself an immense capital, which may be added to or deducted from the sum devoted to support industry. In southern countries, the whole revenue of the nobility was annually dissipated in useless pomp; but to recal the heads of noble families into activity has likewise been found sufficient to give them habits of economy. The great French or Italian proprietor, becoming manufacturer, has at once given a useful direction to the revenue of his land, by adding his own activity to that of a nation becoming more industrious, and added likewise all the power of his wealth, which formerly lay unemployed.

The torpor of a nation may sometimes be so great, that the clearest demonstration of advantages which it might derive from a new species of industry, shall never induce it to make the attempt. Example alone can then awake self-interest. French industry has found, in the single little state of Lucca, more than ten new branches, to employ itself upon with great advantage both for the country and those who engaged in them. The most absolute liberty was not sufficient to direct attention to these objects. The zeal and activity of the Princess Eliza, who called into her little sovereignty several head manufacturers, who furnished them with money and houses, who brought the produce of their shops into fashion, has founded a more durable prosperity in a decaying city; and restored to a beneficent activity, much capital and intellect, which but for her would for ever have remained unemployed

When government means to protect commerce, it often acts with precipitation, in complete ignorance of its true interests; almost always with a despotic violence, which tramples under foot the greater part of private arrangements; and almost always with an absolute forgetfulness of the advantage of consumers, who, as they form by far the most numerous class, have more right than any other to confound their well-being with that of the nation. Yet it must not be inferred that government never does good to trade. It is government which can give habits of dissipation or economy; which can attach honour or discredit to industry and activity; which can turn the attention of scientific men to apply their discoveries to the arts: government is the richest of all consumers; it encourages manufactures by the mere circumstance of giving them its custom. If to this indirect influence, it join the care of rendering all communications easy; of preparing roads, canals, bridges; of protecting property, of securing a fair administration of justice; if it do not overload its subjects with taxation; if, in levying the taxes, it adopt no disastrous system,—it will effectually have served commerce, and its beneficial influence will counterbalance many false measures, many prohibitory laws, in spite of which, and not by reason of which, commerce will continue to increase under it.

CHAP. V.

OF MONEY.

Wealth incessantly circulates from producers to consumers, by means of money. All kinds of exchange are accomplished under this form, whether the means of producing wealth are transmitted from one proprietor to another, or when land or moveable capital changes its owner, or when labour is sold, or when the object destined to be consumed reaches the hands that are to use it. Money facilitates all these exchanges; it occurs among the different contractors as a thing which all desire, and by means of which every one may find what he immediately requires; as a thing, moreover, submitted to invariable calculation, and by means of which all other values may be appreciated, this alone being their scale.

Money performs several functions at once: it is the sign of all other values; it is their pledge and also their measure. As a sign, money represents every other kind of wealth; by transmitting it from hand to hand, we transmit a right to all other values. It is not money itself, which the day-labourer requires; but food, clothing, lodging, of which it is the sign. It is not for money that the manufacturer wishes to exchange his produce, but for raw materials, that he may again begin to work; and for objects of consumption, that he may begin to enjoy. It is not money which the capitalist lends to the merchant to profit by; it is all that the merchant will purchase with this money, immediately afterwards; for so long as the merchant keeps it in the original shape, he can draw no advantage from it, and his capital will not begin its course of production till the money is out of his hands. By an abuse of language, which has caused much error and confusion, the words money and capital have become almost synonymous: money indeed represents all other capital, but it is itself the capital of no man; it is always barren by nature, and wealth does not begin to increase, till after money has left the hands of its possessor.

Money is not only the sign of wealth, it is also the pledge of it. It not only represents wealth, it contains the worth of it. Like wealth, it has been produced by a labour which it wholly compensates. In work and advances of all sorts employed in extracting it from the mine, it has cost a value equal to what it passes for in the world. It furnishes to trade a commodity which is expensive; because, purchased like every other, it is the sole kind of wealth which is not increased by circulation or dissipated by enjoyment. It issues, still without alteration, from the hands of him who employs it usefully, and of him who squanders it upon his pleasures. But the high price at which society acquires money, though at first view it appears an inconvenience, is precisely what gives it the merit of being an imperishable pledge for its possessors. As its value was not given by arbitrary convention, arbitrary convention cannot take its value away. It may be more or less sought after according as it occurs more or less abundantly in the market; but its price can never deviate very far from what would be required to extract an equal quantity from the mine.

Money, in the last place, is a common measure of values. Before the invention of money, it must have been very difficult to compare the value of a bag of corn with that of a yard of cloth. Dress was equally necessary with food; but the processes, by which men procured them, seemed scarcely susceptible of being compared. Money has furnished a common and invariable unity to which every thing can be referred. Nations, who are not acquainted with the use of metals, have, nevertheless, so felt the advantages of this common measure that they have formed an ideal unity to which they refer every kind of value.

The important part which money performs in political economy, and the various properties by which it animates exchanges, and protects and serves to measure them, explain the illusion which has misled, not only the vulgar, but even the greater part of statesmen, and exhibited this commodity in their eyes as the efficient cause of labour, and the creator of all wealth. It is essential for us, however, to pause here, that we may both display those errors in a clear point of view, and firmly demonstrate the principles which follow. In the epoch of civilisation, at which we are arrived, no labour can be accomplished without a capital to set it in motion; but this capital, though almost constantly represented by money, is yet quite a different thing. An increase of the national capital is the most powerful encouragement to labour; but an increase in the circulating medium has not of necessity the same effect. Capitals co-operate powerfully in the annual reproduction of wealth, giving rise to an annual revenue; but money continues barren, and gives rise to no revenue. Indeed, the competition between those capitals which are offered to accomplish the annual labour of the nation, forms the basis for the interest of money; but the greater or less abundance of the circulating medium has no influence in the fixing of this interest.

Painful experience has shown all the inhabitants of Europe what a dearth was, and a period of general penury among a civilized people. At these mournful epochs, every one has heard it a hundred times observed, that it was not corn or food which was wanting, but money. Indeed, vast magazines of corn have often remained full till the next harvest; those provisions, if proportionably shared among the people, would have almost always been sufficient for their support; but the poor, having no money to offer, were not able to buy them; they could not, in exchange for their labour, obtain money, or at least enough of it, to subsist. Money was wanting, natural wealth superabundant. What phenomenon could appear more proper to confirm the universal prejudice which looks for wealth in money, not in consumable capital?

But the money, which is wanting in a time of scarcity, is the wage offered to the workman to make him labour; the wage, by means of which, he would have purchased a subsistence. The workmen never labour, except when some of those who have accumulated capitals, or in other words, the fruit of preceding labours, can profit from those capitals, by furnishing on one hand, the raw material, on the other, a subsistence for the artisan. Labour cannot be carried on so as to produce any material fruit, any fruit capable of becoming wealth, without raw materials on which to operate; the workman cannot labour without food to support him; and, therefore, every kind of labour is impossible without a capital previously existing in objects of consumption to furnish his materials and his wages; and, if the workman himself lay out these advances, it is because he combines for this little object the two characters of capitalist and artisan.

As the workman requires a capitalist, so the capitalist requires workmen; because his capital will be unproductive, if it continue idle; and the revenue which he expects and has to live upon, springs from the labour which he causes to be executed. Hence, whenever he is occupied in a productive enterprise, he employs all his capital in causing labour, and leaves no part of it in idleness. If he is a cloth-maker, and has devoted ten thousand pounds to his manufacture, he does not stop till his ten thousand pounds are done, and he no longer has new sums to employ in the operation. If it be then asked why he stops, he will answer, like the workman, that money is wanting, that money does not circulate.

It is not, however, money which is then wanting any more than in the former case; it is consumption or the consumer's revenue. On commencing his manufacture, the capitalist studied to adjust it to the demand; and he reckoned that as soon as his cloths should be ready, they would be purchased by consumers, whose money, the sign of their revenue, would replace his capital, and become the sign of subsistence to new workmen, to whom he would pay new wages. It is not money which the consumer is in want of, but revenue. Some have had inferior harvests this year; some have gained a smaller interest on their capitals, a smaller share on the annual reproduction of the fruits of industry; others, who have no income but what arises from their labour, have not found employment; or else the whole three classes are not poorer than they were, but the manufacturer had imagined them to be richer, and regulated his production according to an income which does not exist.

Income, of which we have seen all the different sources in the second chapter, is a material and consumable thing; it springs from labour; it is destined for enjoyment; it is exactly of the same nature with the advances in wages and raw material, laid out by the manufacturer; and money is but the sign and the measure of it. The capital it should replace is also composed of material objects, destined for consumption, and incessantly renewed. Money serves but to represent it, and always forms the smallest part of each merchant's funds. We have supposed the cloth-maker to possess L.100,000; but, if half this sum is employed in fixed capitals, it will be sufficient, if his sale amount weekly to L.1200, to give him in the shape of interest and profit 20 per cent. on his circulating capital, and to allow L.1000 weekly in money to maintain an annual production of L.60,000; so that he never possesses in cash more than the fiftieth part of his circulating capital.

An increase of the national capitals is the most powerful encouragement of labour; either because this augmentation presupposes an augmentation of income, and, consequently, of means of consumption; or because these capitals, not being profitable to their proprietor, except as they are employed, each capitalist incessantly endeavours to create a new production by their means. In distributing them to his workmen, he gives to those workmen a revenue which enables them to purchase and consume the preceding year's production; and he sees those capitals return increased by the revenue, which he is to expect from them in the following year's production. But though he distributes and afterwards recovers them, by means of the circulating medium which serves for all exchanges, it is not the circulating medium which forms the essential requisite in his operation. The same cloth-maker, labouring each year on an equal quantity, sends 2400 pieces of cloth to the market, which have been valued at L.60,000, or L.25 a-piece. He exchanges 400 pieces for such objects of consumption as are needed to supply the wants, the enjoyments, the luxuries of himself and family. He exchanges 2000 pieces for the raw materials, and the labour which, within the year, are to reproduce an equal quantity; and thus next year, and every following year, he will have, as before, 2400 pieces to exchange on the same conditions. His capital, equally with his revenue, is actually in cloths, not in money; and the perpetual result of his commerce is to exchange cloth against cloth.

If the consumption of cloth is increased, if by this means his trade, in place of comprehending 2400 pieces annually, comprehends 3000, more labour will, no doubt, be ordered by him and executed by his workmen; but if the money alone is increased, and not the consumption or the income which determines it, labour and production cannot increase. Let us take separately each one of his customers, as he calls them. There is not one of them who does not levy a greater or a smaller portion of his income in kind, but all may arrange matters so as to receive the whole of it in money. They are not, however, more rich on this account; they will not be at more expence; they will not buy more cloth from him, and his trade will experience no kind of augmentation. What happens to individuals may equally happen to nations. The revenue of a country, or the sum total of profits arising from the different kinds of labour amounted, we shall say, last year, and this year to fifty millions; but last year the country levied all its profit in goods, in merchandise destined for its consumption; this year, from some mercantile circumstance, some arrangement of exchanges, it has levied the fourth, the third part, in money imported through the frontiers. It is neither richer nor poorer, for this alteration; its consumption will, as formerly, be fifty millions; and with regard to the money imported, apparently its industry required this money, otherwise it will be again exported. To increase the circulating medium of a country, without increasing its capital, without increasing its revenue, without increasing its consumption, is to do nothing for its prosperity, nothing for the encouragement of labour.

Since no labour can be accomplished without a capital to set it in motion; since no reproduction of wealth can take place without raw materials for the work, and subsistence for the workmen, it follows that the furnisher of those wages and materials has taken the most intimate share in the reproduction; he is in a great degree the author of its profits, and has the most evident right to participate in them. But he who lends a capital lends nothing else but those wages and raw materials represented by money. He lends a thing eminently productive, or rather the only one which is productive; for since all wealth proceeds from labour, and all labour is put in motion by its wage, he lends labour itself, or the first cause of production in all kinds of wealth. Hence, whenever an odious sense has been attached to the word *usury*, meaning by it any kind of interest paid for the use of a sum of money, under pretext that as money produced no fruit, there could be no lawful share of profit, where there was no profit; in this case, an absurd distinction has been formed. There was just as much reason to prohibit the renting of land, or the wages of labour, because without a capital to put land and labour in exercise, both would remain unfruitful.

Theologians, however, were right in saying that gold and silver were barren by nature: they are barren so long as kept in their own shape; they cease to be barren, the instant they become the *sign* of another kind of wealth, which is emphatically productive. Theologians, if they determined to abide by the single principle on which their prohibition was founded, should have been contented with declaring usury criminal, every time the lender obliged the borrower to keep the deposit in its primary form, locked up in a strong box, from the moment of borrowing to that of payment. For it is quite certain that money, whilst locked up, produces no fruit; and neither borrower nor lender can get good of it except by parting with it.

But, if money is of itself barren; if it produces no fruit but in so far as it is the sign of other values, then it is evident that no good can be done by multiplying the sign and not the thing. It is true, if you multiply the sign in a single country, you give this country the means of commanding the thing, provided that thing be found in any other country; but when you multiply the sign in all countries at once, you do nothing for any. At present, there exists such a proportion between the sign and the thing, that a pound sterling is worth a bag of corn; but if, by the stroke of a magic rod, you should instantly double all the money in the world, since every thing to be obtained in exchange would continue the same, two pounds in place of one would be required to represent a bag of corn. The quantity of corn consumed by a workman in food would not be altered, consequently his wage must be doubled. With twice as many guineas, exactly the same work would be done, and nothing would be changed but names and numbers.

Capitalists require their capital to be employed, that it may gain a revenue; and hence they offer it for a certain price, to such as wish to cause labour; workmen, on the other hand, and those who employ workmen, have need of capital for their labour; and, after reckoning up the profit expected from it, they offer a certain share of their advantage to capitalists. The necessities of money-lenders and of money-borrowers come thus to a state of equilibrium in all markets; those classes of men agree upon a medium rate. The regulator of their bargain is always the quantity of labour required by consumers, compared with the quantity of capital, representing raw materials and wages, to be disposed of in executing this labour. If the want is great, and the means of labour small, the interest of money will be considerable; if, on the contrary, there is much capital in circulation, and little employment for it, interest will be very low. It must always be regulated by what is called the quantity of money offered in the market, because money is the sign of capital, though not capital itself. Far from being augmented by the magical increase of money above alluded to, capital would not even be increased by the arrival of money in great abundance at a particular place of trade, without losing any thing of its value in comparison with the things it purchases; and no change in the rate of interest would result from this circumstance.

Nearly all the circulating capital of each manufacturer and trader is successively presented to him under the shape of money, in its return from the buyer to the seller; but the part of his funds, which a merchant actually has in money, forms, in ordinary cases, but a small portion of the capital employed in his commerce; an infinitely greater portion being kept in its original state in his own warehouses, or in those of his debtors. On the other hand, it is almost always in the power of each merchant instantaneously to augment the quantity of money at his disposal, by selling his goods at a less profit, or by discounting the debts which are owed him. In this way, he has money when he pleases, without being richer; the money, far from adding to his capital, is purchased with it. If such operations are performed at one time by several merchants in the same town, that town purchases money from its neighbours; if by a great number of French, English, or German merchants, we say that France, England, or Germany purchases money. There will, in reality, be found much more in the markets to make payments with; guineas will be much more abundant; but there will be neither more nor fewer deposits offered to lend, and the rate of interest will not be any way affected by the change. Such as are acquainted with the movements of trading places, know well that guineas may abound in them while capitals are scarce, or guineas be scarce while capitals abound.

It is a gross error, then, to believe that, in all cases, a considerable importation of the circulating medium will make the rate of interest fall, or an exportation make it rise. Money is a kind of wealth; and, like any other kind of wealth, it forms part of the circulating capital. If the money imported is a gift, or a tribute; if it costs nothing to the nation, it will certainly augment its circulating capital, and must certainly contribute to lower the rate of interest on the spot; but the same sums paid to the nation in goods would equally contribute to that end. If, on the other hand, this money has been purchased with any other portion of the capital, in that case the sum total of the latter will remain the same, and the rate of interest will not be affected.

Upon these principles, it is easy to see how mines of silver and gold do not enrich a nation more than any other kind of industry. The precious metals drawn from the mine are goods purchased, like all other goods, at the price of labour and capital. The opening of the mine, the construction of its galleries, the establishment of refining furnaces, require large advances, independently of the labour by which the ore is drawn from the bowels of the earth. This labour, and its fruits, may be exactly paid by the metal produced, and the state will gain by the operation, as by any other manufacture. But, in general, the profits of mines are irregular. As the head prize in a lottery seduces gamesters, an unlooked for advantage encourages miners to continue their exertions, although the usual returns be inferior to those obtained by any other kind of industry; and nearly all of them are ruined, just like gamesters, because they were at first successful.

From these principles, we may also conclude, that the blame so frequently imputed to Frederic II. and the Canton of Berne, for having hoarded up and withdrawn from the country a large portion of the natural circulating medium, is without foundation. By saving a part of their expences, they, of course, in some degree, diminished consumption and reproduction; by preserving some millions in their coffers, they in some degree diminished the circulating capital: but the money locked up by them was soon replaced by other money, which the country purchased; and, besides, the whole circulating medium of a nation is so small, compared with its whole circulating capital, that such a void can never be considered as a national misfortune, or counterbalance the immense advantage of possessing a fund ready, without new sacrifices, at the moment of want.

From confounding money with capital, has arisen the general mistake of attempting to increase the national capital by a fictitious capital, which, not having been created by an expensive labour, is not, like gold or silver, a pledge of the values it represents; and which, after having delighted nations with the illusions of wealth, has so frequently left them in ruin.

It will be more easy to follow the operation, by which so many states in our time have endeavoured to replace their money by paper, if we previously direct our attention to the manner in which one of the most ancient trading cities of France made a few crowns perform the functions of a considerable circulating medium. At Lyons, it was agreed upon in trade, that all payments should take place only at four fixed periods, quarterly. During the three days which the payments took up, all the accounts of the city were settled at once. Each, at the same period, had much to receive and much to pay. But, on the days immediately preceding the payments, all the merchants used to meet on the exchange, to make what they called *viremens;* in other words, to assign one to another such sums as would settle their accounts. A owed B, who owed C, who owed D, who owed E, himself indebted to A; and the five accounts were settled without any payment. If E was not indebted to A, it was agreed that A should pay E, and the other four were acquitted by a single payment. Every merchant bought but to sell again; received, therefore, but to pay; and if those assignments were extended to their utmost limits, one single sum of ten thousand pounds would probably settle all the transactions of a city, though these amounted to several millions.

But all mutual debts are not equal, and bankruptcies occasion difficulties, and sometimes errors in the assignments. The invention of banks has supplied this deficiency. The Bank of Amsterdam is a kind of open bar, where assignments may constantly be made. Every trader pays or receives, by a line which is written down in the Bank's books on the debtor or creditor side of his account, without any money being disbursed. Among merchants, who have all an open credit with the Bank, the operation of the book-keeper supplies with the utmost ease that of cashier; and no difference of amount, or day of payment, prevents sums from being reciprocally balanced.

A bank like that of Amsterdam, however, is of use only to such as have a current account in it. Many traders may have no account; and few or none who are not traders ever have any, though called, as well as others, to pay and to receive. To extend the advantage of assignments also to the business of such persons, those note-banks were invented which have since become so common in all parts of Europe. Their notes are assignments on the bank, payable to the bearer on demand, Each, by combining several notes, may make his odd payments himself; and hence it is generally most convenient for him to transmit them to others, as he received them, without having drawn any money; and even though each may require payment at his pleasure, no one thinks of it, just because each feeling that he may do it any time, feels always that it will be soon enough afterwards.

Up to that period, banks had done nothing but simplify payments, and save the employment of money, and render circulation easy with a smaller sum than would otherwise have been required. But some one must profit by this saving. In arranging the assignments at Lyons, each profited according to his share in trade; each needed to have money in his coffers only four times yearly, for three days. He, of course, gained interest for the remaining 353 days; and as those assignments simplified all his operations, a smaller sum performed for him the office of a greater. When banks were established, it was they that profited by this saving of money. They received interest, not for the money really given by them, but for the money which every bearer of notes had it in his power to demand from them at a moment's notice. This interest of notes reckoned equal to gold, was a pure advantage for bankers; since the money promised, far from being drawn, had not even remained at the bank, where it would have been barren. Bankers, reckoning on the confidence of the public, had caused it to labour, and recalled it for their payments only as they needed it.

It was by discount on such of the proceeds of trade as were payable at long dates, that banks pushed their notes into circulation. They required an interest for exchanging their paper against that of trade, because theirs was exigible at sight, though it was not really paid before the other. The discount required by the bank served to introduce the interest of money, and to regulate it in the place. Bankers, in virtue of their credit alone, seemed to have capitals of almost immense extent to offer in the service of merchants. Credit soon appeared to have a creative power, and speculators, persuaded that by emitting a bank one, they added as much to the public wealth as, by importing an equal sum of money, delivered their minds to dreams, dangerous for themselves, and for the states that gave ear to them. They proposed the establishment of banks to multiply the funds of trade, to provide for the enterprises of agriculture, to set labour everywhere in motion, to increase the general capital, and redouble the activity of industry.

Governments, on their side, imagined that in banks they had found an open mine, from which they might draw at discretion. At each new season of need, they struck new bank-notes. But they soon perceived, with astonishment, that notes were no longer received with the same confidence, and were speedily carried back to the bank for payment; and next, as their custom generally is, they substituted their authority for the nature of things. They refused payment on demand, but they ordered each citizen to receive as ready coin, those notes which had thus become *paper money;* and they authorized every debtor to pay his accounts with it.

The circulation of paper money became, in a short time, nothing less than a general bankruptcy. Notwithstanding all the orders of government, paper fell every day in its proportion to silver or to goods. The bearers of it, feeling that they had no pledge for the values the sign of which they were always presenting, dreaded lest the paper should undergo a new deterioration in their hands, and made haste to get rid of it. Each lost and caused loss, each having no longer any common measure of value, became unable to distinguish the gain from the loss of his bargain, and always selling with advantage, he ended in ruin. During this time, coin disappeared, goods themselves were exported from the country without giving any return; and the expedient, which promised to create immense wealth, produced nothing but ruin and confusion.

A fatal error had led to all these misfortunes. It was imagined that credit had the power of creating wealth; whilst, in fact, credit never creates any thing, but merely borrows with one hand to lend with the other that wealth, which, to be of use, must have previously existed in the state. Paper money can be substituted only for the metallic money already in existence; it is the value of this which it borrows. The banker, who finds credit, acquires the power to dispose of a part of the currency equal to the paper he emits. If he in reality withdraw part of the currency from circulation, his paper will remain there; if he does not withdraw it, others will withdraw it for him, the instant it becomes superfluous. But, if this currency was not in circulation at the moment when his bank-notes were emitted, he could not borrow it. In that case, by giving forced circulation to his paper, he depreciates not only this paper, but all that was already in the hands of the public.

The money of a country has a determinate relation to the wealth of that country, and to the activity with which its wealth circulates. The same guineas serve, in the course of a year, for a great number of different bargains; yet still there is a necessary equation between the mass of values sold, and the sum of guineas which serves to pay them, multiplied by the rapidity of the circulation. If too many guineas exist in the country for the wants of the circulation, this is not a reason why the person holding them in his coffers should keep them longer than he has occasion so to do. All useless stagnation would be so much interest lost for him; and, therefore, he continues still to give them circulation, and some one is always at hand, who, not finding any profitable use to make of them in the country, takes them out of it. If exportation is forbidden, a greater mass of idle guineas will be kept within the country, till the loss of those unable to employ them be great enough to pay the risk of smuggling. If precautions are so well taken that exportation is entirely impossible, the whole money circulated in the country will fall in value till it be reduced to the equation which it cannot pass; that is, to the numerical value of all the sales and payments made within the year, divided by the rapidity of circulation.

In like manner, if the money of a country is not sufficient for its circulation, the country will purchase money in exchange for some one of the values it possesses, just as it would have purchased any other kind of goods. It is not the balance of trade which can make money enter or leave a country. This balance is completely illusory, for it is not true that nations settle their accounts with each other. On the contrary, indeed, it often happens that one is constantly a borrower, the other constantly a lender. And, the credit sales of the most commercial being renewed from year to year,—before the first debt is extinguished, a second is already contracted, which is followed by a third; and though each is paid in its turn, the purchaser may, nevertheless, perpetually remain debtor to his seller. Thus, sales on credit form a capital which may either increase, or be reimbursed in the inverse sense of other commercial speculations.

Abstracting all that concerns these credits, which modify more than three-fourths of its commercial speculations, the purchases of a nation would be exactly balanced by its sales; because it is as impossible for the one always to purchase, and find the source of a perpetual draining of money, unless it work at mines, as for the other to sell always, and find an employment for a perpetual importation of coined metal. Money is imported, and exported from one nation to another, not because it pays their accounts, but because the one having need of it, sells its goods cheaper, till it has acquired enough; and, because the other having more than enough for its circulation, buys dearer, or gives a greater quantity of guineas for the same quantity of goods, till the equilibrium is re-established.

But as the emission of any sum in bank notes supplies the place of an equal sum of money, the latter is immediately withdrawn from circulation and sold in foreign countries. So long as there remains any coin to be exported, credit may repeat its operation and create new bank notes; when there is no more coin to export, the paper money will, of itself, diminishing in value, seek the proper equation; and to whatever nominal sum its fabrication may be carried, it will never sell, in the total amount, for any thing more than the pre-existing total amount of money which it replaces.

CHAP. VI.

OF TAXATION.

Taxa-

The primary object of political economy is the development of national wealth; but the object of all governments, since they began to bestow any attention on this subject, has been to participate in this wealth, and to acquire the disposal of a greater share of the nation's annual revenue. The ever-increasing necessities of governments, and the excessive expence of wars, have forced princes to load their people with the weightiest possible yoke. Taxation, of itself always an object of repugnance to the subject, has become a nearly intolerable burden; the question is no longer how to make it easy; it is not to do good, but to do the least possible evil, that all the efforts of governments in this respect are limited.

Quesnay's sect of economists, who discovered in the net revenue of land the solitary source of wealth, might also believe in the advantage of a solitary species of taxation. They rightly observe, that government, in justice, ought to apply to him who is destined to pay the tax in the long run; because, if this tax is paid by one citizen, reimbursed by a second, who again is reimbursed by a third, not only will there be three persons instead of one incommoded by this payment, but the third will be so much the more incommoded, as it will be necessary for him to indemnify the preceding two for their advances of money. Upon the same principle, the economists called the tax which weighs on the revenue of land a *direct tax;* to all others they gave the name of indirect, because those taxes arrive indirectly at the person who pays them at last. Their system has fallen, their definitions are no longer admitted, but their denominations have remained in general use.

We have recognised but a single source of wealth, which is labour; yet we have not recognised but a single class of citizens, to whom the revenues produced by labour belong. These are distributed among all the classes of the nation; they assume all manner of forms, and, therefore, it is just that taxation should follow them into all their ramifications. Taxation ought to be considered by the citizens of a state as a recompence for the protection, which government grants to their persons and properties. It is just that all support this, in proportion to the advantages secured them by society, and to the expences it incurs for them. The greater part of the charge arising from social establishments, is destined to defend the rich against the poor; because if left to their respective strength, the former would very speedily be stripped. It is hence just that the rich man contribute not only in proportion to his fortune, but even beyond it, to support a system which is so advantageous to him; in the same way as it is equitable to take from his superfluity rather than from the other's necessaries. Most public labours, most charges for defence, and for the administration of justice have territorial rather than moveable property in view; it is hence, farther just, that the landed proprietor be taxed in proportion higher than others.

After the sources of income have become various, it cannot be supposed that a single tax will reach them all, unless it assume as a basis this income itself, the valuation of which, in any form, would give room to the most arbitrary and vexatious inquisitions. The tax, though single, would in that case lose all the advantages of simplicity. It was better then, for contributors, as well as for government, to multiply taxes, that each by itself might be lighter, and the whole might better reach every class of persons. Governments have therefore multiplied partial taxes. They have taken wherever they have found any thing to take; and though flattering themselves with having thus reached all their subjects, it would be impossible for them to appreciate how much is asked of each class, and consequently to maintain the proportional equality which justice would have required. On the other hand, contributors like better to submit to this heavy inconvenience, than to the obligations of exhibiting an account of their incomes, which often they do not know themselves, and to a division on arbitrary grounds; which most frequently would be intolerable.

In establishing those different taxes, four rules appear of essential importance for rendering each tax as little burdensome as possible. Each citizen must contribute, if he can do so, according to the proportion of his fortune; the collection must not be expensive, that so the tax may cost as little to the people as possible. beyond what it brings into the treasury; the term of payment must be suitable to the contributor, who might frequently be ruined by an unreasonable demand of what he could pay, without constraint, if his convenience were consulted; and, finally, the citizen's liberty must be respected, that so he may not be exposed otherwise, than with extreme caution, to the inspection of revenue-officers, to the dependent, and all the vexatious measures too often connected with the levying of taxes.

Among the taxes that reach with any equality all classes of contributors, some are proportioned to the income of each, others to the expence of each. These two ways of estimating fortunes seem capable of being adopted indifferently; and, if the expence is not proportionate to the wealth, there is no inconvenience, if the impost, which is regulated by this expence, be as it were, a bonus on economy, or a fine on prodigality. Tithes, the land-tax, the income-tax, are destined to reach what the contributor receives. Taxes on consumable articles are the chief species of contribution on expenditure. There remains, however, a great number of other taxes, which cannot be arranged under these two heads, and which, accordingly, are not in proportion to the contributor's fortune.

The revenue most easily attained by taxation is that which proceeds from land; because this species of wealth cannot be concealed from sight; because, without the proprietor's declaration, the value of it may be known, and because in gathering the produce at the moment when nature grants it, we are sure exactly to meet the proprietor's convenience for paying it. But economists are divided in opinion as to the two modes of collecting this tax, the one in kind from the unaltered product, the other in money from the proprietor's net revenue.

Tithes, a tax, according to the first of those methods, is levied at the moment of abundance, before the producer has in any shape taken possession of his property. The rule, according to which tithes are established, is so universal, that few discussions or vexations arise from it, and this gives it a great appearance of equality. The collection of a tax in kind requires a great number of clerks and warehouses, and hence it is expensive; but this inconvenience might be repaid, if government, after the collection, kept in its granaries the corn delivered to it, till a period more favourable for sale. As cultivators generally cannot wait for this period, the loss suffered by a premature sale would, perhaps, of itself, cover all the charges of collection. Combining such advantages, a national impost in the shape of tithes has seduced many political speculators. Tithes have also been defended with obstinacy by the powerful body to whom they are in general abandoned. Those advantages do not extend to what are called small tithes, an impost vexatious in all its details; the difficult collection of which is an ever-fresh root of hatred between the curate and his parishioners, though the impost was intended to unite them all as a single family.

But the advantages of tithes, in any shape, are more than compensated by their real inequality, and the obstacles they oppose to industry. The expence of cultivation is far from being the same in good and in bad soils, in good and bad years; yet the reimbursement of that expence is made by part of the crop, and this part at least should not be subjected to any tax, for fear of destroying the reproduction of the following year. It is not the revenue alone that is tithed; but at the same time all the seed, the manure, the days of labour, which have produced the crop: for all this, the latter ought to restore. In good years, and good soils, two sheaves in ten may represent all these advances: in bad years or soils, eight in ten will scarcely cover them; it is not very rare even that the whole crop is insufficient to pay the expences. Tithes, however, are equally levied in all those cases; from the first they take an eighth part of the land revenue; from the second a half; from the third, which is nothing, they take a portion of the capital destined to produce the following crop; and their inequality is the more cruel, because it is always the poor whom they oppress, taking most from the very persons whose necessity requires most moderation.

Again, the more productive a mode of cultivation is, the more advances does it need to have committed to the ground. Tithes, which are but the seventh or eighth part of the revenue in a pasturage, become the fifth in a field of corn, the third in a vineyard, the half in a hop-yard or in a field of hemp, and the whole in a garden. Thus, whilst the national interest incessantly requires the raw produce to be incessantly increased by committing larger advances to the ground,—tithes instruct the cultivator incessantly to diminish his advances, and follow that species of culture which gives back least to the nation, but which also least exposes him who undertakes it to be punished for his industry.

The land-tax has not the same inconveniences; it affects only the net revenue; it is enabled to reach it with equality enough, and above all, with a regularity which screens the contributor from every arbitrary proceeding, and which, therefore, is to him more precious than justice itself. On being established, it strips the proprietor of a considerable portion of his fortune, for he loses all at once a part of the very capital whose rent alone must pay the tax; but this loss, after having struck him, is never repeated. From that time he no longer looks upon this capital as belonging to him; a new purchaser, on buying the land, does not pay him any price for this portion; the state has become thenceforth its true proprietor. On the other hand, this territorial impost often requires money from such as have none; it forces them to sell their commodities to obtain the quantity wanted, perhaps at the most unfavourable moment; and it thus contributes to cause a glut in the market at the moment of harvest, and a scarcity at the year's end. Besides, if too heavy, it discourages the proprietor from laying out new advances upon land which he looks upon as scarcely any longer his.

If the capitalist could as easily be come at as the proprietor of land, it would be quite as just to tax him directly for the support of a government which guards his property. The interest of money would be a taxable material, fully as suitable as the rent of land. But the capitalist's wealth cannot be known without a vexatious inquest, which, in trading countries, would be destructive to credit. Capitals, moreover, are not attached to the soil, and if loaded with imposts, the capitalist would be induced to transmit them into other countries, often without emigrating himself. He would thus deprive his country of all the labour which those capitals would support; he would diminish the national revenues in a proportion immensely superior to the advantages which the treasury could expect from the new tax.

Other species of revenue escape still more easily from direct contribution. A considerable revenue in the state, for example, is the profit of trade, and that of manufactures; but, on being directly taxed, it is almost sure to be annihilated. Another very considerable revenue is that of workmen, who gain but a mere wage; the great number of those who enjoy it makes up for the slenderness of the portion belonging to each. Such, also, are the revenues of all those classes whose labours leave no products which are substantial and capable of accumulation. Most men who live by those different means do not even know the extent of their revenue, because, receiving it day by day, and expending it in the same manner, they think they have nothing when their labour is all that remains. They form the poorest class of society, but also the most numerous; and, if we add up the annual consumption of all the day-labourers, it is greatly superior in value to that of all the rich.

But before we think of taxing this revenue we must remember, that nothing can be more absurd, as well as cruel, than to take away a part of the necessary emolument of productive workmen; for, either it must actually be paid by them, in which case they would suffer, languish, and at last die of penury, and with them would also be destroyed the national revenue which should spring from their labour; or else they would succeed in obtaining reimbursement for their contribution, either on the class which employs them, or on that of consumers. For this purpose they would raise either all their wages, or the price of all their produce. Thus they would raise manufactures, or, at least, shut foreign markets; and, by a circuit a little longer, they would equally arrest production, and destroy the national revenue. No operation, however, could be more difficult than to separate in a poor man's revenue the necessary from the superfluous, which alone can be taxed. Besides, such a tax would be to fix contribution on labour and industry; or, in some degree, to inflict a penalty on those qualities which it is the most essential to encourage; it would be to arrest, at their source, the wealth and prosperity of states. Such are the motives which have generally prevented a universal tax on income; or, at least, have prevented it from reaching the industrious classes completely enough to become productive.

But those different kinds of income, which cannot be appreciated for taxation at their origin, are always employed in consumption; and this is the moment when taxation can reach them with far less inconvenience. By taxing every kind of goods in the purchasing of which wealth may be employed, we are sure to make that wealth contribute, and we need not know to whom it belongs. For such a contribution there is not required any declaration of fortune, any inquisition, any distinction of poor and rich; it does not attach taxation to labour; it does not punish what ought, above all other things, to be encouraged. Besides, each contributor pays his taxes on consumption as it were in a voluntary manner, at the time when he has money, and finds himself enabled to purchase the thing taxed; he reimburses the merchant, who has already advanced the impost, and he scarcely perceives that himself has paid any.

Taxes on consumption are, however, very far from being able to reach the revenue in a correct manner by means of the expenditure. It is required, for example, that every kind of fortune, every kind of industry, protected by the state, should pay the treasury ten per cent. of the revenue which they give. At first view it appears, that this object would be obtained by taxing every consumption, every expence, of what nature soever, at ten per cent. of its value. But if we attempt to come at every kind of consumption, we must subject to the same tax the commodities produced in the interior of families by domestic industry, those produced by the national manufactures, and those introduced by foreign commerce. By making exceptions to this rule, not only would the principle of equality be destroyed in a very unjust manner, but also each would be induced to serve himself, greatly to the prejudice of manufactures, trade, and the division of labour, which much increases its productive power. On the other hand, by following it rigorously out, each family would be subjected to an inspection of its domestic economy absolutely insupportable.

The universality of such a tax would have a still more fatal inconvenience, if it were extended to commodities of prime necessity. By exempting such commodities, a very considerable portion of the national expenditure is left out; but, in taxing them, the risk is run of confounding the necessary with the superfluous in the poor man's consumption; and should the former be encroached on, of arresting the re-production of revenue, either by the penury and death of the workman, or by the rising of his wages.

In the last place, no idea could be entertained of taxing goods destined for exportation; because, whenever the price of them was raised, foreign consumers would provide themselves elsewhere; it would be necessary, in that case, to restore by drawbacks all the customs levied on them. But how could endless frauds upon this principle be avoided? The vexatious laws intended to subject foreign commerce to a constant superintendence, to prevent such frauds, would alone be equivalent to a heavy contribution.

It is a great inconvenience of taxes on consumption, that it never can be known at their establishment who is to pay them in the long run. The legislature always proposes to make them be reimbursed by the consumer; but sometimes they do not reach his distance; at other times, they do not stop at him, and the consumer is anew reimbursed for them by those for whom he labours. To make the consumer pay the whole tax, the nation must be in a state of increasing prosperity; for, otherwise, as the consumer is not richer than before the tax, he cannot devote more money than formerly to his enjoyments, and must, therefore, in some shape diminish his consumption. The producer, on his side, no longer selling the whole of his goods, must diminish his production, or consent to pay a portion of the tax. If a public calamity happens, a scarcity or even a state of embarrassment in trade, consumption still farther diminishes; and the producer, compelled to dispose of his goods, pays the whole tax; till, no longer finding any profit in his labour, he abandons it entirely.

On the other hand, when taxes and consumption have raised the price of every thing, industrious men, who form a numerous class among consumers, no longer find in their industry sufficient resources to support them. His wages no longer furnish the day-labourer with those limited enjoyments, which are to be reckoned among the necessaries of life, since life, or the power of labouring, could not long be maintained in an individual deprived of every pleasure. He struggles, therefore, with all his strength to get his wages increased; the manufacturer and merchant, in like manner, to get their profits increased. As the total sale diminishes, it is necessary for their subsist-should not even be hastened, that the salvation of the state may yet be attempted. There remains no chance to shield the whole subjects of the state from ruin; but if the creditors are allowed to perish first, perhaps the debtors will escape; if the debtors perish from penury, with them will be extinguished the last hope of the creditors, who must soon perish in their turn.

CHAP. VII.

OF POPULATION.

Population.

We have defined political economy, as being the investigation of the means, by which the greatest number of men in a given state may participate in the highest degree of physical happiness, so far as it depends on government. Two elements, indeed, must always be received in connexion by the legislature; the increase of happiness in intensity, and the diffusion of it among all classes of subjects. It is thus that political economy, on a great scale, becomes the theory of beneficence; and that every thing which does not in the long run concern the happiness of men belongs not to this science.

The human race, originating in a single family, has multiplied, and spread itself by degrees over the globe; and much time was of course required, before it could be adjusted to the means of subsistence, which different parts of this globe are capable of supplying. We see this work of nature repeated in new countries, or in a colony established in a desert region. A state which passes from barbarism to a higher stage of civilization, cannot all on a sudden become covered with as many inhabitants as it may comfortably support: as the earth has been wasted several times; as the greater part of its provinces have been by turns plunged into a state of desolation, to arise from it slowly afterwards, we have often had the opportunity of witnessing this spectacle of a growing population. We are accustomed to consider it as the mark of prosperity and good government; and hence our law and constitution all tend to favour this increase, though to increase the symptoms of prosperity is very different from increasing prosperity itself.

Nature has attended to the multiplication of races with a kind of profusion. Although that of man is among the slowest in its progress, it may increase when all circumstances are favourable, far more quickly than any of our observations indicate. When every man has a great interest in bringing up a family, and has the means of doing so; when all marry, and all as young as nature permits; when they continue to have children till the approaches of old age, their posterity increases so as very quickly to occupy all the allotted space. In several countries, in consequence of the social organization, not above a fourth part of the individuals marry; the rest grow old in celibacy. Yet this fourth is of itself sufficient to keep up the population at the same level. If their brothers and sisters could also marry with the same advantage, the population would be quadrupled in a single generation.

Thus, every nation very soon arrives at the degree of population which it can attain without changing its social institutions. It soon arrives at counting as many individuals as it can maintain with a revenue so limited, and so distributed. If a great transient calamity, a war, a pestilence, a famine, have left a great void in the population, should those events be followed by a period of general security and comfort, this renewing power of human generation is speedily developed; and an observer is astonished to see how few years are required to obliterate all traces of a scourge, which seemed to have unpeopled the earth. But, on the other hand, so soon as this term has been reached, a greater increase of the population is a national calamity; the earth soon consumes those whom it cannot feed. The more numerous births are, the more will mortality display its ravages, to maintain constantly the same level; and this mortality, the effect of misery and suffering, is preceded by the lengthened punishment, not of those who perish only, but of those who have struggled with them for existence.

In every country, it is essential to know well those different periods of increase, of stagnation and decline, in order to adapt the laws, and all social institutions, to the circumstances; and not, as has too frequently been done, to hasten, with all our efforts, the destruction we ought most to fear.

So long as a great part of the country is uncultivated; as land proper for liberally rewarding rural labour is covered only with spontaneous production; as even the part under tillage is imperfectly worked; as the soil is not rendered healthy, the marshes drained, the hills protected against precipitations, the fields defended against the ruinous force of nature; so long as all this is not done merely for want of hands,—it is desirable for the happiness of agriculturists, and for that of the nation living on their labour, that the class of cultivators should be increased, and enabled to accomplish the task reserved for them.

So long as the objects produced by the industrious arts are imperfectly supplied to the consumer, or at least as he cannot procure them except by a sacrifice quite disproportionate to their value; so long as he is constrained to furnish himself coarsely by domestic industry, for want of opportunity to buy furniture, effects, clothes, proper for his use; so long as his enjoyments are restricted by the inconveniences of all the utensils with which he is obliged to content himself,—it is desirable that the manufacturing population increase; since, from the need there is of such a population, it might evidently live in comfort, and contribute to the enjoyment of other classes.

So long as all hands are in such a degree necessary for agriculture, and manufactures, or trade which serves them, that the guardian professions, equally useful to society, are badly filled up,—it is desirable that population continue to increase, that so interior order, security of person and property, may be better protected, health better attended to, the soul better nourished, the mind more enlightened; and that society may be externally defended with sufficient force, comprehending even the rapid recruitment of a sea or land army, which consume population.

This population, indeed, whenever it is required, will quickly be replaced. But it is not enough that it be replaced, if it cannot find the niche, to which it is destined. Sometimes a fertile soil is in vain abundant, and remains uncultivated. There is no chance of the most numerous population assembled in its neighbourhood coming to profit by its resources. This soil has become the property of a few families; it is declared indivisible and unalienable; it will always pass to a single proprietor, according to the order of primogeniture, without the capacity either to be subjected to an emphyteutic lease, or burdened with a mortgage. The proprietor has not the capital necessary for its cultivation; he can give no security to such as have this capital, that will engage them to employ it in his land.

Thus the idle population of Rome in vain calls for labour; the waste Campagna di Roma in vain calls for labourers: the social organization is bad; and so long as this shall remain unchanged, the day-labourer will perish from penury, on the surface of fields which, for want of culture, are returning to their wild state; and the population, far from increasing, will diminish.

On the same principle in manufactures, the rich proprietors of Poland will in vain require all the produce of luxury; the bad condition of the roads, prohibiting every distant transport, will in vain present superior advantages to national industry; oppression and servitude destroy all energy, all spirit of enterprise in the lower class. Elsewhere ruinous monopolies, absurd privileges, affrighting advances, ignorance, barbarity, and want of security, will render the progress of manufactures impossible; no capital will be accumulated to animate them. In those cases, to increase the population will not increase industry. The births will in vain be doubled, be quadrupled, during a certain number of years; they will not afford an additional workman, they will only be followed by a proportionably quicker mortality. The social organization is bad; so long as this shall remain unchanged, population cannot increase.

The guardian population is fed as well as recruited by the other classes. It is not sufficient that many children are born; unless their parents enjoy a certain degree of opulence, they can never bring them up to the age of men; the prince can never make soldiers of them. In this case, wars by land or sea will devour the population: whilst they employ only its superfluity, the social organisation is good.

The population is always measured, in the long run, by the demand for labour. Wherever labour is required, and a sufficient wage offered, the workmen will arise to earn it. The population, with its expansive force, will occupy the place which is found vacant. Subsistence will also arise for the workmen, or in case of need, be imported. The same demand which calls a man into existence, will likewise recompense the agricultural labour which provides him with food. If the demand for labour cease, the workman will perish, yet, not without a struggle, in which not he alone will suffer, but all his brethren and his rivals. The subsistence which enabled him to live, and which henceforth he cannot pay for, and cannot demand, will in its turn cease to be produced. Thus, national happiness rests on the demand for labour, but on a regular and perpetual demand. For, on the contrary, a demand which is intermittent, after having formed workmen, condemns them to suffering and death: it would be far better if they never had existed.

We have seen that the demand for labour, the cause of production, must be proportional to revenue which supports consumption; that this revenue, in its turn, originates in the national wealth, which wealth is formed and augmented by labour. Thus, in political economy, all things are linked together, we move constantly in a circle, since each effect becomes a cause in its turn. Yet all things are progressive, provided that each movement is adjusted to the rest; but all stops, all retrogrades, whenever one of the movements which ought to be combined is disordered. According to the natural march of things, an augmentation of wealth will produce an augmentation of revenue; from this will arise an increase of consumption, next an increase of labour for reproduction, and therewith of population; and, finally, this new labour will, in its turn, increase the national wealth. But if, by unreasonable measures, any one of those operations is hastened without regard to all the rest, the whole system is deranged, and the poor are weighed down with suffering instead of the happiness which was anticipated for them.

The object of society is not fulfilled, so long as the country occupied by this society presents means of supporting a new population, of enabling it to live in happiness and abundance, whilst yet those means are not resorted to. The multiplication of happiness over the earth, is the object of Providence; it is stamped in all his works, and the duty of men in their human society is to co-operate in it.

The government which, by oppression of its subjects, by its contempt for justice and order, by the shackles it puts on agriculture and industry, condemns fertile countries to be deserts, sins not against its own subjects alone; its tyranny is a crime against human society, on the whole of which it inflicts suffering; it weakens its rights over the country occupied by it, and as it troubles the enjoyments of all other states, it gives to all others the right of controlling it. All men are mutually necessary to each other. Europe has a double need of the subsistence which it might procure from Barbary, if this magnificent shore of Africa were given back to civilization, and from the consumers we should soon find there. The institution of property is the result of social conventions. In a society subjected to laws and a regulating government, the interest of each may be implicitly relied on for producing the advantage of all, because the aberrations of this private interest are in every case of need limited by public authority. But, in the great human society formed among independent nations, there is no law or general government to repress the passions of each sovereign: besides, the interest of those sovereigns is not necessarily conformable to that of their subjects; or, to speak more correctly, the one is contrary to the other, whenever the object of the rulers is to maintain their tyranny. Thus, respect for the pretended right of property claimed by each government over its territory, is not referable to the right of private property, and, besides, it cannot be reciprocal. The same circumstances which cause a tyrannical government to impede its own civilization, render it equally incapable of respecting that of its neighbours, and submitting to the laws of nations.

But whilst more than three quarters of the habitable globe are, by the faults of their governments, deprived of the inhabitants they should support, we, at the present day, in almost the whole of Europe, experience the opposite calamity, that of not being able to maintain a superabundant population, which surpasses the proportion of labour required, and which, before dying of poverty, will diffuse its sufferings over the whole class of such as live by the labour of their hands. For our part, we owe this calamity to the imprudent zeal of our governments. With us, religious instruction, legislation, social organization, every thing has tended to produce a population, the existence of which was not provided for beforehand. The labour was not adjusted to the number of men; and, frequently, the same zeal with which it was attempted to multiply the number of births, was afterwards employed in all arts to diminish the required number of hands. The proportion which should subsist in the progress of the different departments of society has been broken, and the suffering has become universal.

Mr. Malthus, the first writer who awakened public attention to this calamity, under which nations have long suffered, without knowing it, whilst he gave an alarm to legislators, did not reach the true principles which he seemed on the road to find. On reading his writings, one is struck at once with an essential error in his reasoning, and with the importance of the facts to which he appeals. Such confusion, in a matter to which the happiness of man is attached, may produce the most fatal consequences. By rigorously applying principles deficient in accuracy, the most grievous errors may be committed; and if, on the other hand, the error is discovered, there is a risk of simultaneously rejecting both the observations and the precepts.

Mr. Malthus established as a principle that the population of every country is limited by the quantity of subsistence which that country can furnish. This proposition is true only when applied to the whole terrestrial globe, or to a country which has no possibility of trade; in all other cases, foreign trade modifies it; and, farther, which is more important, this proposition is but abstractly true,—true in a manner inapplicable to political economy. Population has never reached the limit of subsistence, and probably it never will. Long before the population can be arrested by the inability of the country to produce more food, it is arrested by the inability of the population to purchase that food, or to labour in producing it.

The whole population of a state, says Mr. Malthus, may be doubled every twenty-five years; it would thus follow a geometrical progression: but the labour employed to meliorate a soil, already in culture, can add to its produce nothing but quantities continually decreasing. Admitting that, during the first twenty-five years, the produce of land has been doubled, during the second we shall scarcely succeed in compelling it to produce a half more, then a third more, then a fourth. Thus the progress of subsistence will not follow the geometrical but the arithmetical progression; and, in the course of two centuries, whilst the population increases, as the numbers, 1, 2, 4, 8, 16, 32, 64, 128, subsistence will increase not faster than the numbers, 1, 2, 3, 4, 5, 6, 7, 8.

This reasoning, which serves as a basis to the system of Mr. Malthus, and to which he incessantly appeals through the whole course of his book, is completely sophistical. It opposes the possible increase of the human population, considered abstractly, and without regarding circumstances, to the positive increase of animals and vegetables in a confined place, under circumstances more and more unfavourable. They ought not thus to be compared. Abstractly, the multiplication of food follows a geometrical progression, no less than the multiplication of men. It follows it only in a much more rapid manner. In a given space and time, this progression is not followed any more by the one species than the other. Population is arrested first, and arrests subsistence in its turn; when the obstacle is removed, both begin again to increase, till they reach a new limit equally common to both; and the history of the universe has never yet presented the example of a country in which the multiplication of food could not be more rapid than that of the coexistent population.

In a state absolutely savage, men live on the produce of hunting and fishing. The fish and the game are multiplied like man in a geometrical progression, but much more rapid than the one he follows. Man, it is true, hinders their reproduction, by destroying them; but, on the other hand, they arrest his; for it is not certainly among nations of hunters that the population is doubled every twenty-five years; and whenever this destruction is suspended, the reproduction of game will be much more rapid than that of men.

The progress of civilisation substitutes the pastoral life for a life of hunting; and the natural produce of the ground, better managed, is sufficient for a much more numerous population of men and of animals. The deserts, which scarcely support five hundred Chirokee hunters, would be sufficient for ten thousand Tartar shepherds, with all their flocks; the multiplication of the latter is always much more rapid than that of men; whilst the production of a man requires twenty-five years, that of an ox requires but five, of a sheep but two, of a hog but one. The number of oxen may be doubled in six years, that of sheep in three, that of hogs may be rendered ten times as great in two years. Whenever a shepherd gains possession of a country formerly abandoned to hunting, the multiplication of his flocks will greatly precede that of his family; when, afterwards, one of the two is arrested, the other will be so too.

But when civilization makes a new step, pastoral nations abandon their flocks for agriculture; and instead of trusting to the natural productions of the vegetable kingdom, they produce and multiply them by their labours. It is calculated that thirty families may live on the corn produced by a piece of ground, which would have supported only a single family by its produce in cattle. At the time, therefore, when a nation passes from the pastoral to the agricultural state, it in some sense acquires a country thirty times as large as the one it formerly occupied. If the whole of this country is not cultivated, if even in the most civilized kingdoms there remains a vast extent of fertile land still employed in unprofitable pasturage, it is an evident proof that other causes than want of subsistence prevent the development of population.

The multiplication of vegetables follows a geometrical progression much more rapid still than the multiplication of cattle. In common tillage, corn increases fivefold in the course of a year; potatoes tenfold in the same space of time. The latter vegetable, to produce a given quantity of food, scarcely requires the tenth part of the ground which corn would occupy. Yet even in the most populous countries, men are very far from having planted all their corn fields with potatoes; from having sown all their pasturages with corn; from having converted into pasturage all their woods, all their deserts abandoned to hunting. Those things are a fund of reserve remaining to every nation; and by means of them, if a new demand for labour should suddenly cause the population to increase as rapidly as the nature of man can permit, the multiplication of food would still precede it.

The demand for labour which the capital of a country can pay, and not the quantity of food which that country can produce, regulates the population. In political economy, nothing is reckoned a demand but what is accompanied with a sufficient compensation for the thing demanded. If no fault has been committed on the part of government, if no dangerous prejudice has been diffused among the people, very few men will think of marrying, and burdening their hands with the subsistence of individuals unable to procure it themselves, till they have first acquired an establishment. But whenever a new demand for labour raises their wages, and thus increases their revenue, they hasten to satisfy one of the first laws of nature, and seek in marriage a new source of happiness. If the rise of wages was but momentary; if, for example,

example, the favours granted by government suddenly give a great development to a species of manufacture which, after its commencement, cannot be maintained, the workmen, whose remuneration was double during some time, will all have married to profit by their opulence; and then at the moment when their trade declines, families disproportionate to the actual demand of labour will be plunged into the most dreadful wretchedness.

It is those variations in the demand for labour, this sort of revolution so frequent in the lives of poor artisans, that gives to the state a superabundant population. Already brought into the world, that population finds no longer any room to exist there; it is always ready to be satisfied with the lowest terms on which it may be permitted to live. There is no condition so hard that men are not found ready to engage in it voluntarily. In some trades, the workmen are obliged to live in mud, exposed to continual nausea; in others, the labour engenders painful and inevitable maladies; several stupify the senses, degrade the body and the soul; several employ none but children, and after introducing into life, abandon to a horrible indigence the being they have formed. There are callings, in fine, which public opinion brands with infamy: there are some which deserve this condemnation. Yet the ranks are always full; and a miserable wage, a wage scarce sufficient for existence, induces men to undergo so many evils. The reason is, society does not leave them any choice; they are compelled to be contented with this cruel lot, or not to live. The duty of governments to succour so much wretchedness cannot be doubtful, for they are almost always the cause of this wretched population's being created; but, at the same time, they ought not to forget that it is their part to save from indigence the miserable creatures already in existence, though at the same time discouraging them from perpetuating their race. Assistance given to the poor has often done the contrary.

Religious instruction has almost always strongly contributed to destroy the equilibrium between the population and the demand for labour, which is to give it subsistence. When questions of moral polity are introduced in a religious system, it almost constantly happens that the cause of the precept is absolutely separated from the precept itself; and a rule which should be modified by circumstances, becomes an invariable law. Religions began with the origin of the human race; and therefore at a time when the rapid progress of population was everywhere desirable: their principles have not yet changed, now when the unlimited increase of families has given birth only to beings, of necessity condemned to physical suffering or moral degradation.

A Chinese knows no greater misfortune, no deeper humiliation, than not to leave sons behind him to perform the funeral honours at his death. In almost all other creeds the indefinite increase of families has ever been represented as a blessing of heaven. On the other hand, whilst religion repressed irregularity of morals, it attached all morality of conduct to marriage; and washed away, by the nuptial benediction alone, whatever was reprehensible in the imprudence of him who inconsiderately contracted the bonds of paternity. Yet how important soever purity of morals may be, the duties of a father towards those whom he brings into existence are of a still higher order. Children born but for wretchedness, are also born but for vice. The happiness and the virtue of innocent and defenceless beings are thus sacrificed beforehand to satisfy the passions of a day. The ardour of casuists in preaching up marriage to correct a fault; the imprudence with which they recommend husbands to shut their eyes upon the future, to entrust the fate of their children to Providence; the ignorance of social order, which has induced them to erase chastity from the number of virtues proper in marriage, are causes which have been incessantly active in destroying the proportion which naturally would have established itself between the population and its means of existing.

The Catholic faith has sometimes gained credit for its religious vows, which, by forbidding marriage to a certain number of individuals, seemed to offer some opposition to an unlimited multiplication of the human species. But those who consider it thus, certainly do not understand another very important part of the legislation of casuists, with regard to all that they have named the duties of husbands. Considering marriage as solely destined for multiplication, they have made a sin of the very virtues which they enforce on single persons. This morality is enforced by every confessor on every father and mother of a family. The effects of it are powerfully felt in the social organization of Catholic countries. They are met with even in reformed churches.

When fatal prejudices are not honoured; when a system of morality contrary to our true duties towards others, and above all towards those indebted to us for life, is not taught in the name of the most sacred authority, no wise man will marry till he is in a condition that affords him sure means of living, no father of a family will have more children than he can conveniently maintain. The latter expects that his children will be satisfied with the lot in which he has lived; hence he will wish the rising generation exactly to represent that which is departing; he will wish that a son and a daughter, arrived at the age of marriage, should fill the place of his father and his mother; that his children's children should fill his place and his wife's in their turn; his daughter will find in another house exactly the lot which he will give to the daughter of another house in his own; and the income which satisfied the fathers will satisfy the children.

When once this family is formed, justice and humanity require that they submit to the same constraints which single people undergo. On considering how small is the number of natural children in every country, it ought to be admitted, that this constraint is sufficiently effectual. In a country where population cannot increase, where new places do not exist for new establishments, the father who has eight children should reckon either that six of his children will die young; or that three contemporary males and their contemporary females; or in the following generation three of his sons and three of his daughters, will not marry on his account. There is no less injustice in the second calculation than cruelty in the first. If marriage is sacred; if it is one great means of attaching men to virtue, and recompensing the chagrins of declining years, by the growing hopes of allowing an honourable old age to succeed an active youth, it is not because this institution renders lawful the pleasures of sense, but because it imposes new duties on the father of a family, and returns him the sweetest recompense in the ties of husband and father. Religious morality ought therefore to teach men, that marriage is made for all citizens equally; that it is the object toward which they should all direct their efforts; but that this object has not been attained except so far as they are able to fulfil their duties towards the beings whom they call into existence: and after obtaining the happiness of being fathers, after renewing their families, and giving this stay and hope to their declining years, they are no less obliged to live chastely with their wives than single persons with such as do not belong to them.

Self-interest powerfully warns men against this indefinite multiplication of their families, to which they have been invited by so fatal a religious error; and no one ought to be disquieted, if this order is observed remissly. In general, at least three births are required to give two such individuals as arrive at the age of marriage; and the niches of population are not so exactly formed that they cannot by turns admit a little more and a little less. Only government ought to awaken the prudence of citizens deficient in it, and never to deceive them by hopes of an independent lot, when this illusory establishment shall leave them exposed to misery, suffering, and death.

When peasants are proprietors, the agricultural population stops of itself, when it has brought about a division of the land, such that each family is invited to labour, and may live in comfortable circumstances. This is the case in almost all the Swiss cantons, which follow nothing but agriculture. When two or more sons are found in one family, the younger do not marry till they can find wives who bring them some property. Till then they work day labour, and live by means of it. But among peasant cultivators the trade of day labour does not afford a rank; and the workman who has nothing but his limbs, can rarely find a father imprudent enough to give him his daughter.

When the land, instead of being cultivated by its proprietors, is cultivated by farmers, metayers, day-labourers, the condition of the latter classes becomes more precarious, and their multiplication is not so necessarily adjusted to the demand for their labour. They are far worse informed than the peasant proprietor, and yet they are called to perform a much more complicated calculation. Living under the risk of being dismissed at a day's notice from the land they till, it is less a question with them what this land will give, than what is their chance of being employed elsewhere. They calculate probabilities in place of certainties, and commit themselves to fortune with regard to what they cannot investigate. They depend on being happy; they marry much younger; they bring into the world many more children, precisely because they know less distinctly how those children are to be established.

Thus metayers, day-labourers, all peasants depending on a master, being more imperfectly able to judge of their situation by themselves, ought to be guided and protected more carefully by government. Landed proprietors wield all the force of monopoly against them; whilst day-labourers, acting in competition with each other, are finally reduced to work for the most wretched subsistence. Those measures are wise, therefore, which have been adopted by legislators to fix the minimum share that should fall to each peasant. It would in general be a beneficent law which should permit no division of a metairie below a certain limit, no reduction below a half on the metayer's part. It is a beneficent law which has fixed the peasant's lot in Austria; a law, which should invariably fix the Russian peasant's capitation to his landlord, would be equivalent to an emancipation from serfage, and free from all the convulsions of such a step. The Russian nation could not perhaps receive a greater benefit from its government. The statute of Elizabeth, in fine, was wise in prohibiting a cottage from being built without at least four acres of land being allotted to it. Had this law been executed in England and Ireland, no marriage could have happened among day-labourers without a cottage to shelter the family, no cottager would have been reduced to the last degree of penury.

The industrious population which inhabit towns, have still fewer data than those of the country for calculating the lot of the succeeding generation. The workman knows only that he has lived by his labour; he naturally believes that his children will do so likewise. How can he judge of the extent of the market, or the general demand for labour in his country, whilst the master who employs him is incessantly mistaken on these points? Accordingly this class, more dependent than any other on chances of every kind for its subsistence, is exactly the class which calculates those chances least in the formation of a family. They are the people who marry soonest, produce most children, and consequently lose most; but they do not lose their children, till after being themselves exposed to a competition which deprives them successively of all the sweets of life.

At the time, when all towns were distributed into bodies of tradesmen, when a calling could not be exercised till the applicant had been united to a corporation, a workman never married till after he had been *passed master*. A reception into the trade gave him the certainty of being able to maintain his family; an excessive competition did not expose the great mass of the population to the danger of dying from hunger. Thus, all the institutions created in the republics of the middle ages, and reproduced in Queen Elisabeth's statute of apprenticeship, though keenly attacked by Adam Smith for establishing a monopoly contrary to the consumer's interest, may be defended, not in regard to the increase of riches, but as forming a necessary obstacle to the immoderate increase of population.

Yet because the system which we follow has made us experience a calamity, we ought not to imagine that no escape is to be found except by rushing into the opposite extreme. It is not by the suppression of corporations alone, that we have disproportionately increased the manufacturing population. It is much more by the inordinate encouragement which all governments at the same time have given to production without attending to consumption. We have already pointed out the results of this imprudent struggle in regard to the increase of wealth. They have been still more disastrous in producing and supporting with deceitful hopes a population, which has afterwards been abandoned to all the horrors of want.

A state ought doubtless to receive with gratitude, whatever new industry the wants of consumers may develope; but it also ought to allow the industry, which is quitting it, to depart without any effort to the contrary. When the profits of a manufacture diminish, new workmen do not engage in it; former workmen withdraw; and after some years of suffering, too long and too cruel, by any mode of treatment, the level is again established. But if the favours of government keep up the staggering manufacture; if trying to save it, government offers bounties for the discovery of any machine which shall spare manual labour, it will prolong suffering, and save the manufacturer only at the expence of those whom that manufacturer should support.

The guardian population presents the same species of suffering in another rank of society. War multiplies the commissions of officers in the army and navy; the complicacy of administration multiplies the places of judges and civil agents of all kinds. Religious zeal multiplies the places for pastors. All of them live on pensions with a certain degree of opulence; none of them knows, or is able to insure the fund which affords him subsistence. They reckon on ushering their children into the same career with themselves; they bring them up, multiply their families in proportion to their actual opulence, and blindly repose on the future. Their pension however finishes with their life; and at death they leave their children in a state of indigence, the suffering of which is farther aggravated by the possession of a liberal education. The laws which obstruct the marriage of officers, judges, clergymen, and generally of all such as live on pensions, how hard soever those laws may appear at their first establishment, are justifiable, because they save from poverty the class to which its torments would be most piercing.

But an inordinate increase of population is not the only cause of this national suffering. The demand for labour may decrease, and the population continue stationary. Consumption may be arrested, revenues dissipated, capital destroyed, and the number of hands formerly occupied may no longer be able to find a sufficient employment. The population immediately follows the revolution of the capitals destined to support it. As day-labourers are more eager to receive even the smallest wage, than merchants to employ their money, the former are laid under conditions more and more hard, as the demand on the capital diminishes; and they conclude by contenting themselves with so miserable a remuneration, as is scarcely sufficient to maintain them alive. No enjoyment is any longer attached to the existence of this unhappy class; hunger and suffering stifle in them all the moral affections. When every hour is a struggle for life, all passions are concentrated in selfishness; each forgets the pain of others in what himself suffers; the sentiments of nature are blunted; a constant, obstinate, uniform labour debases all the faculties. One blushes for the human species, to see how low on the scale of degradation it can descend; how much beneath the condition of animals it can voluntarily submit to maintain life; and notwithstanding all the benefits of social order, notwithstanding the advantages which man has gained from the arts, one is sometimes tempted to execrate the division of labour, and the invention of manufactures, on beholding to what extremes of wretchedness they have reduced beings created equal with ourselves.

The misery of the savage hunter, who dies so frequently of hunger, is not equal to that of millions of families, whom a manufacture sometimes dismisses; because at least there remains to the former all the energy and all the intelligence, which he has put to proof during all his life. When he dies for want of finding game, he yields to a necessity which nature herself presents, and to which he knew from the beginning, he must submit as to sickness or to old age. But the artisan, dismissed from his workshop with his wife and children, has beforehand lost the strength of his soul and his body; he is still surrounded with riches; he still sees beside him, at every step, the food which he requires; and if society refuses him the labour by which he offers till his last moment to purchase bread, it is men, not nature, that he blames.

Even when persons do not actually die of hunger; even when the aids of charity are eagerly administered to all indigent families, discouragement and suffering produce their cruel effects on the poor, the diseases of the soul are communicated to the body, epidemics are multiplied, children die in a few months after their birth, and the suppression of labour causes more cruel ravages than the cruellest war: besides, fatal habits, either of mendicity or idleness, take root in the population; another course is given to trade, another direction to fashion, and even after death has cleared the ranks of workmen, those who remain are no longer in a condition to support the competition of foreigners.

The causes of diminution in the demand for labour, often belong to polity, properly so called, rather than to political economy. There is perhaps none more efficacious than the loss or diminution of liberty. When a nation begins to alienate this precious possession, each citizen thinks himself less secure of his fortune or the fruits of his labour; each abates something of the activity of his mind, and his spirit of industry. The virtues which accompany labour,—sobriety, constancy, economy,—give place to the vices of idleness, to intemperance, dissipation, and forgetfulness of the future. Trade, industry, activity, are regarded with contempt, in a state where the people are nothing, whilst all distinction, all honours, are reserved for noble indolence. Favour, intrigue, flattery, and all the arts of courtiers, which debase the soul, are roads to fortune, much more sure and rapid than strength of character, bold and enterprising activity, or a spirit of speculation. Intriguers are multiplied daily; they regard with contempt those who follow the only honourable path to fortune, that in which none makes progress except by his merit or his labour.

One cause of depopulation is, however, presented, which lies within the narrowest range of political economy. The progress of the arts, the progress of industry, and hence even that of wealth and prosperity, discover economical methods of producing all the fruits of labour by employing a smaller number of workmen. Animals are substituted for men in almost all the details of agriculture; and machines are substituted for men in all the operations of manufactures. So long as a nation finds within its reach a market sufficiently extensive to secure for all its productions a prompt and advantageous circulation, each of those discoveries is an advantage, because instead of diminishing the number of workmen, it augments the mass of labour and its produce. A nation which happens to originate discoveries, succeeds for a long time in extending its market in proportion to the number of hands set free by every new invention. It immediately employs them in augmenting the produce, which the discovery promises to furnish at a cheaper rate. But a period arrives at last, when the whole civilized world is but one market, and when new customers cannot be found in new nations. The demand of the universal market is then a precise quantity, which the different industrious nations dispute with each other; if one furnish more, another must furnish less. The total sale can only be increased by the progress of general opulence, or because conveniences formerly confined to the rich, are brought within the reach of the poor.

The invention of the stocking-frame, by means of which one man does as much work as a hundred did before, was a benefit for humanity, only because, at the same time, the progress of civilization, of population, and of wealth, increased the number of consumers. New countries adopted the customs of Europe; and this article of dress, formerly reserved for the rich, has now descended to the poorest classes. But if, at the present day, some new discovery should enable us, by a single stocking-frame, to do the work which ten years ago was done by a hundred, this discovery would be a national misfortune; for the number of consumers can scarcely increase, and it would then be the number of producers which would be diminished.

This example may show us the general rule: Whenever a discovery, economizing labour, brings within the reach of a poorer class what was previously confined to the rich, it extends the market; and whilst benefiting undertakers and poor consumers, it does no harm to workmen. But when the discovery cannot increase the number of consumers, though it serves them at a cheaper rate, either because they are already all furnished, or because the thing produced can never be useful to them, however low it may fall,—the discovery becomes a human calamity; because it is advantageous, but to a certain manufacturer, and that only at the expence of his brethren; or it benefits a single nation, and that only at the expence of others. This national benefit, if purchased at the expence of wretchedness and famine to foreign artisans, would not in itself be much worth coveting; it is, besides, very far from being certain. From the progress of communication between different states, from the skill of manufacturers, a discovery in one country is imitated in every other before the former has gained any great profit from it.

It will doubtless be said, that whoever introduces a saving in any article of his consumption, preserving still the same revenue, will consume what he saves from the fall of price in such and such an article, by a new expenditure, for which he will put in requisition a new labour. But there never will be any proportion between this new demand and the labour suspended on account of it.

On one hand, consumers make use of goods a little finer, a little prettier at the same price. The clothes with which the poor workman is dressed, are a little superior in quality, are really worth a little more, than those which covered his father at the expence of the same part of his wages. But himself does not perceive this advantage. Decency, which, according to his station, he is obliged to consult, leaves him no choice; he must dress like his equals, without finding more enjoyment; he makes no saving in this article, he cannot apply it to any other expence.

On the other hand, the price of goods is not always established in direct proportion to the labour they require, but in a very complicated proportion subsisting between this annual labour, the circulating capital, and a primary, unrenewed labour, consumed in building the manufactory, constructing the machinery with expensive and often foreign materials. Hence, even when a hundred workmen are dismissed, that the work may be done with one by means of machinery, the goods are not reduced to the hundredth part of their price. The stocking-frame economizes work nearly in this proportion, yet it scarcely produces stockings ten per cent. cheaper than those made with the needle. Notwithstanding the invention of large mills for spinning wool, silk, cotton, women continue to be employed in spinning with the wheel, or even with the distaff; a certain proof that the saving does not exceed ten per cent. The same observation may be extended to all improved manufactures: they have never diminished the price of their produce, except in arithmetical progression, while they have suspended workmanship in geometrical progression.

Let us compare this saving in workmanship with the saving in price, according to the most simple calculation on the commonest manufacture. A hundred thousand women, who knit with the needle each a hundred pair of stockings annually, produce 10 million pairs; which, at 5s. a-piece, would sell at £2,500,000: the raw material is worth a fifth of this. There remains £2,000,000 to distribute among 100,000 workmen, or £20 a-head.

The same work is done at present on the frame by 1000 workmen, and comes in ten per cent. cheaper at 4s. 6d. a pair, or £2,250,000 in all. The nation therefore saves £250,000. If employed solely in workmanship, this sum would be sufficient to maintain 12,500 of the workers who have been dismissed. But this is not what happens; the consumer accustomed to buy stockings at 5s. a pair, pays still the same price; but by reason of the progress of the art, he merely wears them a little finer. This progress in his luxury gives subsistence to a tenth more stocking manufactures, that is, to a hundred more; to these add still farther a hundred workmen employed in repairing the machines or constructing new ones, and you have in all 1200 workmen living on the sum which supported 100,000.

The same calculation is applicable to all improved manufactures; for the manufacturer, in adopting a new machine, and dismissing his workmen, never troubles himself with inquiring whether he shall make a profit equal to the diminution of workmanship, but merely whether he shall be enabled to sell a little cheaper than his rivals. All the workmen of England would be turned to the street, if the manufacturers could employ steam engines in their place with a saving of five per cent.

Besides, the improvement of machinery, and the economy of human labour, contribute immediately to diminish the number of national consumers; for all the ruined workmen were consumers. In the country, the introduction of the large farming system has banished from Great Britain the class of peasant farmers, who laboured themselves, and yet enjoyed an honest plenty. The population has been considerably diminished, but its consumption is reduced still farther than its number. The hinds perform all sorts of field labour, are limited to the scantiest necessaries, and give not nearly so much encouragement to the industry of towns as the rich peasants gave before.

A similar change has taken place in the population of towns. Discoveries in the mechanical arts have always the remote result of concentrating industry within the hands of a smaller number of richer merchants. They enable men to perform with an expensive machine, that is to say, with great capital, what was formerly performed with a great labour. They discover the economy which exists in management on a great scale, the division of operation, the employment common to a great number of men at once, of light, fuel, and all the powers of nature. Thus small merchants, small manufacturers disappear; and our great undertaker supplies the place of hundreds, who all together perhaps were not as rich as he. All together were, however, better consumers than he. His expensive luxury gives far less encouragement to industry than the honest plenty of a hundred households, of which his household supplies the place.

As even new demands made manufactures prosper, the number of labourers, in spite of the augmented powers of labour, increases likewise; and such as were dismissed from the country found still an establishment in manufacturing towns, the population of which continued to increase. But now when at last the market of the universe has been found sufficiently provided for, and new reductions of workmen have occurred; when hinds have been dismissed from the fields, spinners from the mnufactories of cotton, weavers from those of cloth; when each day a new machine supplies the place of several families, whilst no new demand offers them an occupation or a livelihood; distress has reached its height, and one might begin to regret the progress of this civilisation, which, by collecting a greater number of individuals in the same space of ground, has but multiplied their wretchedness, whilst in deserts it could at least but reach a small number of victims. One might also regret that governments have studied too late, and neglected too constantly the precepts of a science, which, teaching the origin of national prosperity, points out beforehand its danger, and the causes of its destruction.

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Polo-Marco
‖
Polynesia.

POLO-MARCO, or Mark Paul. See the article Geography, Vol. X. p. 143.

POLYBIUS, a celebrated Greek historian, was born at Megalopolis, in Arcadia, about the year 203 before Christ. He was the son of Lycortas, a prætor of the Achean republic. Having been educated as a statesman and a soldier, he was one of the deputies sent to negociate with Ptolemy Epiphanes. He obtained great distinction while fighting against the Romans in Macedonia, and, when Perseus had been conquered, he was taken to Rome as a prisoner of war. His bravery and learning were, fortunately for himself, well known and highly appreciated, and he received great kindness from Scipio and Fabius. After seventeen years absence from his native country, he was permitted to return with his fellow prisoners; but, dreading to witness the humiliation of his native land, he accompanied Scipio Emilianus into Africa, and was present at the taking of Carthage and Numantia. Upon the death of Scipio he returned to Megalopolis, where he spent the remainder of his life, amidst the gratitude and esteem of his countrymen. In consequence of a fall from his horse, he died at the age of eighty-two.

A great part of the leisure of Polybius was occupied in the composition of a history, commencing at the second Punic war, and terminating with the subversion of the Macedonian kingdom, a space of fifty-three years. It was contained in thirty-eight books; and two introductory ones, containing an epitome of Roman history, from the taking of Rome by the Gauls. The first five books only of this work remain entire, with large fragments of the next twelve. Though the style is not good, the work has been admired for its accuracy and fidelity. The best editions are, that of Casaubon, Paris, 1609, folio; of Gronovius, 3 vols. 8vo. Amsterdam, 1670; and of Schwevghauser, 7 vols. 8vo. Leipsic, 1785.

POLYGAMY, from πολυς, *many*, and γαμεω, *to marry*, is the name used to designate the custom of marrying more than one wife. This custom is prohibited in all Christian countries. It was permitted among the Jews; and it exists among the Mahometans and all the various religious sects that have prevailed in Asia.

POLYGON. See Geometry.

POLYGRAPH, from πολυς, *many*, and γραφω, *to write*, is the name given to a machine for taking several copies of a piece of writing at once.

POLYNESIA is a name given by various authors, and adopted by Pinkerton, to the extensive tract of Asiatic Islands in the Pacific Ocean lying between the meridians of 130° east and 120° west long. and between 25° north and 32° south lat. These islands may be arranged as follows:

IN THE NORTHERN HEMISPHERE.

1. The *Pelew Islands*, already described in this work, Vol. XVI. p. 350.

2. The *Ladrones*, or *Marian Isles*, described in Vol. XII. p. 498.

3 The *Caroline Islands*, or New Philippine Islands. These islands, discovered by the Spaniards in 1616, were named after their sovereign Charles II. They are about 150 in number, and very populous, with the exception of three, which are uninhabited. Hogolen is the largest, being about 90 miles long, and 40 broad. Yap, on the western extremity of the chain, is only about one-third of this size. An account of these islands, and of the inhabitants by Cantova, will be found in the *Histoire Generale des Voyages*, tom. XV. p. 81.

4. The *Sandwich Islands*, see Vol. XVII.

IN THE SOUTHERN HEMISPHERE.

1. The *Marquesas*, described in this work, Vol. XIII. p. 317.

2. The *Society Islands*, see Vol. XVIII.

3. The *Friendly Islands*, described in this work, Vol. IX. p. 754.

Polytheism
‖
Pompeii.

POLYTHEISM. See Mystery and Mythology.

POMEGRANATE. See Horticulture, Vol. XI. p. 227.

POMERANIA. See Prussia and Sweden.

POMONA Island. See the article Orkney Islands, Vol. XVI. p. 2.

POMPEII, or *Pompeium*, an ancient city of Naples, is said to have derived its name from the triumphant pomp in which Hercules led his captives along the coast after he conquered Spain. It was partly destroyed by an earthquake in A. D. 63, and afterwards rebuilt; but in A. D. 79, it was completely buried by another eruption from Mount Vesuvius, and the same one which destroyed Herculaneum.

Till the middle of the 18th century the very name of the town had been almost forgotten; but a spirit of research having been at that time excited respecting Herculaneum and Pompeii, great and curious discoveries have been made respecting both these ancient towns.

As Pompeii seems to have been destroyed by a shower of ashes, the excavations were more easily effected than at Herculaneum, which was covered with lava, and consequently a greater progress has been made in clearing out the public buildings.

On entering the city, the attention of the traveller is first arrested by the remains of ancient barracks, which had been the quarters of a legion of Roman soldiers. Behind these barracks are two theatres, one small, and supposed to have been covered, and the other large; but both of them were lined with marble, finely paved, and every way highly finished. They were nearly entire when they were first discovered; but though all their decorations have been removed, they still retain their characteristic features. Their form is exactly the same as that of the Teatro Olimpico of Palladio at Verona, having, like that theatre, a narrow proscenium and three entrances of different sizes from the scenery behind to the stage.

A temple of Isis stands behind the little theatre, and occupies an angular space between two streets. Various statues of Venus, Priapus, &c. were found in niches of this temple; but they have been transported, along with the furniture, marble, and pictures, to Portici.

Behind this temple, and on one side of it, is a court surrounded with a portico, and supported with sixteen Doric columns. A sort of pulpit which exists on one side of it, has given rise to the opinion that it had been the place of meeting of some public assembly. There is also here another court, with a similar portico, surmounted by more than 60 stone pillars, of the Doric order, but bordering, in their proportion, on the Tuscan. This court communicates with the grand portico of the theatre; and near it are strewed several fragments of columns of a much larger size, and of a much bolder proportion, which may perhaps have belonged to the temple of Neptune, and may have been thrown into their present situation by the earthquake of A.D. 63. The street, which extends from the neighbourhood of the soldiers barracks is only about *thirteen* feet wide. It is paved with large stones, which are not of a square shape, but are fitted to each other in their original form. On each side are foot pavements nearly *three* feet wide, and elevated *two* feet above the middle pavement, which is marked by two deep rents or furrows, which prove that the carriages always kept the same line, and that there was not room for two.

On both sides of the street, the houses stand quite in contact with each other, as in modern times. They are nearly of the same height and dimensions, being similarly paved and painted. They seem also to have had shops of different kinds. The houses, which are all on a small scale, consist generally of one, but sometimes of two stories. The principal apartments are always behind, surrounding a court, with a small piazza about it, and having a cistern of marble in its centre.

An edifice, supposed to be the house of Sallust, has an unusually showy appearance. The rooms are painted with the figures of gods and goddesses, and the floors decorated with marbles and mosaic pavements. In another house which is large, but less sumptuous in its ornaments, many of the domestic utensils have been preserved; and the kitchen and the offices are under ground. Two houses had glass windows; but in others shutters only were used. The decorations are principally basso-relievos in stucco, and paintings in medallions.

In the main street, which passes in front of the temple of Isis, the portico of the theatre has been discovered; and near the same spot, ten feet below the level of the street, was found a human skeleton, and immediately beneath it a large collection of gold and silver medals in the finest state of preservation, and chiefly belonging to the reign of Domitian.

Beneath a superb portico in the street of the tombs, a number of skeletons have been discovered, among which are those of a female and several children. Among the bones were found several ear-rings and three finger-rings. Among the vases which were discovered, there were two full of water, and having a small quantity of water at the bottom. The water was limpid and tasteless in the one; but in the other it was of a brownish tinge, and had the taste of lye.

One of the most curious and most complete objects that has yet been discovered at Pompeii, is a villa at a little distance from the town. It consists of three courts. In the first and largest of them is a pond, having in the centre an *ædicula*, or little temple. There are numerous apartments of every description, which are paved with mosaic, and have their walls decorated with paintings in a very superior style. The baths in this villa seem to have been objects of particular care.

A public edifice is said to have been recently discovered near the Forum of Pompeii. It is supposed to be the Chalcidicum, and it has an inscription which imports that the edifice was built at the expence of the priestess Eumachia. A few days after this discovery, a statue of the same priestess was found in perfect preservation. It is said to surpass in grace, elegance, and grandeur, all the works of art that had previously been dug from that town.

It has been remarked that Pompeii bears a strong resemblance to modern Italian towns, and that, in point of general appearance, it is superior to them.

The excavations at Pompeii are, we believe, still prosecuted. More than 500 feet of the town wall have been completely cleared. It is from *eighteen* to *twenty* feet high, *twelve* feet thick, and is fortified at short intervals with square towers.

Among the recent discoveries at Pompeii may also be enumerated a bronze vase, encrusted with silver, the size and form of which have been much admired; and a bronze statue of Apollo, of admirable workmanship. The deity is represented as sacrificing, with his avenging arm, the family of Niobe; and the beauty of its form, and the life of the figure, are so fine, that it is said to be the finest statue in the Bourbon Museum.

In the year 1819 several surgical instruments were discovered in the ruins of a house in the *Strada Consulare*, near the gate adjoining to the burial ground. These instruments consisted of probes, made of iron; an iron instrument for extracting teeth; an elevator, used in the operation of trepan; a cauterising iron; a female catheter, made of iron; instruments for bleeding; cutting instruments; spatulas of different forms; and a catheter, with double curvature, like the letter S, and containing the very instrument which a celebrated and respectable French surgeon, Jean Louis Petit, considered as his own invention. All these instruments are remarkable for the elegance of their form, and show that the Romans had arrived at great perfection in this department of the arts. A full account of these different instruments, with a lithographic sketch, was laid before the Medical Society of Emulation at Paris, by Dr. Sevenko, of St. Petersburg, and has been published in the *Bulletin* of that society for November, 1821, p. 452.

POMPEY, Cneius, a celebrated Roman general, was the son of Cneius Pompeius Strabo and Lucilia, and was born in the year 107 before Christ. Pompey began his military career against Cinna, in the Marian civil war, and served under his father, who commanded an army in the neighbourhood of Rome, and who rendered himself unpopular by his avarice and severity. Terentius, a young patrician, having been engaged by Cinna to murder both the father and the son, Pompey got information of his designs, and by retiring from his tent in the night, and placing a guard round the prætorium, he defeated the intentions of his enemies. Some time afterwards his father was killed by lightning, and

Pompey.

the ascendancy of Marius and Cinna deluged the capital with blood.

Attached to the interests of Sylla, Pompey levied three legions for his cause. In the 26th year of his age he succeeded in reducing Sicily, and in 40 days he recovered all the territories in Africa that had forsaken the cause of his master. The Romans were astonished at such rapid and unexpected success, and a dread of the rising power of Pompey induced Sylla to recall him to Rome. On his arrival at the capital, Sylla saluted him with the appellation of *Great*; but the ambition of Pompey required something more for its gratification, and when he was refused a triumph, he exclaimed, "That there were more worshippers of the rising than of the setting sun." Sylla, alarmed at the boldness of the speech, yielded to a Roman knight a triumphal procession through the streets of the capital. Upon the death of Sylla, Pompey opposed the Marian faction under Lepidus. He put an end to the war which had been occasioned in Spain by the revolt of Sertorius, and though still a private citizen, he was honoured by a second triumph. Being soon afterwards made consul, he restored the tribunitial power to its original dignity, and in 40 days he put down the pirates in the Mediterranean, who had nearly destroyed the naval power of Rome. By the influence of Manilius and his other friends at Rome, he was appointed to carry on the war against Mithridates, king of Pontus, and Tigranes, king of Armenia; and such was the success of his operations, that he defeated Mithridates in a general engagement, and soon afterwards received the submission of the Armenian king. After conquering the Albanians and Iberians, he visited countries which were then scarcely known at Rome; and at one time he received homage from twelve crowned heads. Entering Syria, and pushing his conquests as far as the Red Sea, he subdued Arabia, reduced Judea to the state of a Roman province, and returned to his native country in all the pomp and state of eastern magnificence. The Romans, though dazzled with all this splendour, had too much wisdom not to dread the popularity and influence of such a man. Pompey, anticipating this feeling, prudently disbanded his army, and entered Rome as a private citizen. The Romans honoured him with a triumph, and gazed for three successive days on the spoils of eastern grandeur which preceded the conqueror's chariot. Twenty thousand talents were added to the public treasury, and the revenues of the state were raised from 50 to 85 millions of drachmæ.

The dignified elevation to which Pompey was now raised, procured him many enemies. Under the modest guise of a private citizen, it was obviously his ambition to hold the first place in the republic. In wealth he was still inferior to Crassus and Lucullus. The republican faction watched him with a well-founded jealousy; and Cæsar was busily though secretly engaged in laying a broad basis for his boundless ambition.

With the view of increasing his power, and pulling down his enemies, Pompey united himself with Cæsar and Crassus,—a combination of heterogeneous elements which external causes alone could keep together. In the division of the provinces among this triumvirate, Pompey received Africa and Spain, Crassus was made governor of Syria, and Cæsar was contented with the remainder, and with the possession of the government of Gaul for other five years. The death of Julia, however, the daughter of Cæsar, whom Pompey had received in marriage, and the total defeat and slaughter of Crassus in Syria, dissolved this disjointed confederacy, and left the empire of Rome to Pompey and Cæsar.

The history of the civil war which followed these events has been so minutely given in the life of Cæsar, that it is unnecessary to repeat it in this place. See CÆSAR; Vol. V. p. 198. After the battle of Pharsalia, Pompey fled for protection to Ptolemy, king of Egypt, and arrived in the bay of Alexandria. When a boat was sent to bring him on shore, Pompey left his galley, after a tender parting with his son and his wife Cornelia. The Egyptian sailors received him on board with a gloomy silence, and the moment he disembarked he was assassinated by Achillas and Septimius; an event which happened 48 years before Christ, and in the 58th or 59th year of his age. His head was cut off and sent to Cæsar, and his body was left for some time naked on the sea-shore. One of his freedmen, however, of the name of Philip, formed a burning pile, and deposited the ashes of his master under a mound of earth. Cæsar erected a monument to his memory, and the emperor Valent afterwards repaired it at his own expence. Cneius and Sextus, the sons of Pompey, endeavoured for a time to oppose the power of Cæsar; but they soon sunk beneath his arm. Cneius fell in the battle of Munda, and Sextus was put to death by Antony about 35 years before Christ.

POMPEY'S PILLAR, a very interesting monument of antiquity, which has been already briefly described under the article EGYPT, Vol. VIII. p. 396. Since that article was written, much curious information on this subject has appeared in the late Dr. Clarke's *Travels*, the substance of which we shall now endeavour to communicate.

Pompey's pillar is visible from almost every spot in the neighbourhood of Alexandria. The inscription upon its pedestal, supposed to contain the name of the emperor Diocletian, was not known to exist when Dr. Clarke visited Egypt, although it had been mentioned by Maillet and Pococke. After gazing for some time in utter astonishment at the sight of a column of granite *eight feet* in diameter, and *sixty-three* feet high, Mr. Hamilton expressed a wish to find some part of the inscription. The four sides of the pedestal were accordingly examined, but not a trace of any existing inscription could be discovered. This inscription, however, was afterwards discovered by Lieutenant-Colonel Squire. He observed that the letters Π and Ο were legible enough, and he clearly perceived by the remains of the characters that it consisted of *four* lines in Greek. Mr. Hamilton was at this time in Upper Egypt; but upon his arrival in Alexandria, when the attempt to copy the inscription had begun, he assisted in taking a fac-simile of it, and observed the letters which are now believed to complete the name of the emperor Diocletian. The letters observed are ΔΙΟ ΙΑΝΟΝ, which have been supposed by some to be ΔΙΟΚΛΗΤΙΑΝΟΝ, *Diocletian*; and by others ΔΙΟΝ ΑΔΡΙΑΝΟΝ, *the divine Adrian*. In favour of this last supposition it should be stated, that Sicard, who examined the inscription long ago, declared the fourth letter to be N and not K. The veneration of Diocletian's name has been ascribed to the *supposed* gratitude of the people of Alexandria to Diocletian for an allowance of corn; but Dr. Clarke remarks, that history affords no authority either for the tribute itself, or the grateful feelings which it is supposed to have excited. Hadrian, on the contrary, was pre-eminently entitled to their gratitude. He performed also, according to Dio Cassius, funeral rites to Pompey, as Julius

Cæsar had done before; and it is related both by Lucan and Valerius Maximus, that when the head of Pompey was brought to Cæsar at Alexandria, he caused it to be burned with odours and the most solemn rites, and its ashes to be enshrined within an urn. As it was sometimes customary among the Romans to place their cinerary urns on the pinnacles of lofty monuments, Dr. Clarke considers it as highly probable, that Pompey's Pillar was a sepulchral monument erected by Cæsar, to preserve the urn which contained the ashes of Pompey's head.

In support of this very plausible theory, Dr. Clarke mentions that Appian remarks, that the head was buried, but that Cæsar ordered a shrine to be constructed over it, (in the suburbs of Alexandria, a situation exactly answering to the site of Pompey's Pillar,) which he dedicated to Nemesis, the protecting goddess of the reliques of the memory of deceased persons. Appian adds, that this shrine was overthrown in the time of Trajan, which explains the cause of its restoration by Hadrian. Pococke likewise mentions, that some Arabian historians call the pillar the palace of Julius Cæsar.

Dr. Clarke therefore proposes to read the inscription thus:

POSTHUMUS, PRÆFECT OF EGYPT, AND THE PEOPLE OF THE METROPOLIS, (HONOUR) THE MOST REVERED EMPEROR THE PROTECTING DIVINITY OF ALEXANDRIA, THE DIVINE HADRIAN AUGUSTUS.

With regard to the column itself, Dr. Clarke remarks that the shaft is of much earlier antiquity than either the capital or the pedestal. He observed that the pedestal did not rest upon the sand; but by removing the sand, he found that this immense pile, consisting of pedestal, shaft, and capital, was sustained upon a small prop of stone about four feet square, exactly as described by Paul Lucas, (*Voyage fait par ordre de Louis XIV. en* 1714, tom. ii. p. 23, Amst. 1744,) though this is denied by Norden. "Around this central base," says Dr. Clarke, "but in very irregular positions, had been placed other masses, the sepulchral fragments of ancient Egyptian monuments, which did not appear to contribute to the support of the column, but to have been brought there for the purpose of maintaining the prop in its adjusted situation, until the pedestal could be raised upon it." The prop consists of Egyptian breccia, and its four sides are covered with hieroglyphic figures, which are inverted, so that the stone is turned upside down, and must have formed part of some more ancient ruins.

For further information on this curious subject, the reader is referred particularly to Clarke's *Travels*, vol. iii. p. 254—270, where there is an excellent representation of the pillar and of the hieroglyphics. See also Pococke's *Description of the East*, vol. i. p. 8; Hamilton's *Ægyptiaca*, p. 403, Lond. 1809; Norden's *Travels in Egypt*, vol. i. p. 16; and Brotier's *Annot. in Tacit. Hist.* lib. iv. cap. 84.

PONDICHERRY, *Puducheri*, a town of Hindostan, in the Carnatic, and the capital of the French settlements in India. The town, built in a circular form, is situated near the sea-shore on a sandy plain, which produces only palm trees, millet, and a few herbs. As a commercial town, Pondicherry has no natural advantages, and during the period when it was no longer the capital of the French possessions, it speedily fell into decay. The French inhabitants having been reduced by the late war to the greatest distress, were unable to repair their houses. Hence the appearance of the town suffered greatly. The destruction of its fortifications was owing to the mistaken policy of the French government. In 1758, M. Lally was ordered to destroy all the British fortifications that might fall into his power, and he implicitly obeyed that order when he took Fort St. David. When Colonel Coote took Pondicherry in 1761, he retaliated, by levelling the fortifications to the ground, and removing the glacis into the ditch.

At the peace of Amiens, when it was restored to the French, the inhabitants were estimated at 25,000, and the revenue at 40,000 pagodas. Mr. Milburn states, that the Black town of Pondicherry contains a population of nearly 80,000 souls. East Long. 79° 51′ 45″, and North Lat. 11° 55′ 41″. See Hamilton's *East India Gazetteer*; and Milburn's *Oriental Commerce*, vol. i. p. 377. See also the article INDIA, Vol. XII. p. 42, 50, &c. for an account of the history of Pondicherry.

PONTEFRACT, or POMFRET, a borough and market town of England, in the West Riding of Yorkshire. It is agreeably situated near the river Aire, not far from its junction with the Calder, and consists of three principal streets nearly parallel, which are intersected by smaller ones. The streets are spacious and clean, and the houses in general handsome and well built. The parish church, once a magnificent building of Gothic architecture, is now a ruin, and divine service is performed in a chapel. There are here places of worship for the Methodists, Quakers, Roman Catholics, and other dissenters; likewise a charity school for 24 boys and 12 girls, and a free grammar school endowed by Edward VI. The town-hall is an elegant modern building, erected at the joint expence of the county and the corporation. The theatre is a neat building, erected by subscription a few years ago. A small portion of the old castle of Pontefract still exists. It occupied a large site upon an elevated rock. The trade of the town is inconsiderable. It is noted chiefly for its extensive nursery grounds, large plantations of liquorice, and its great horse fairs. In a garden is an ancient cave, the history of which is unknown. Races are annually held here; and the accounts of cloths fulled at all the fulling mills, in the West Riding, are made up here every year. The town is governed by a mayor, recorder, and twelve aldermen. It sends two members to Parliament; and the number of voters is about 330. The population of the borough and township in 1821, was 927 houses; 937 families; 600 families employed in trades; 200 in agriculture; 2095 males, 2352 females, and a total population of 4447. See Boothroyd's *History of the Ancient Borough of Pontefract*, 1807; and *the Beauties of England and Wales*, vol. xvi. p. 881-898.

PONTINE MARSHES. See ITALY, vol. xii. p. 366.

PONTUS, an extensive country of Asia Minor, lying between the 41st and 23d degree of North Latitude, and bounded by the Euxine Sea on the north; by Armenia Minor on the south, by Colchis on the east, and by the river Halys on the west.

PONT ST. ESPRIT, a town of France, in the department of the Gard, situated on the right bank of the Rhone. The town is ill built, and the streets crooked and gloomy. It is chiefly celebrated for its magnificent bridge on the Rhone, which has been fully described, and a drawing of it given in our article BRIDGE, Vol. IV. p. 483, &c. and Plate LXXXIII. There are here some silk manufactures, and a population of 4100.

PONTY POOL, or *Pont ap Howell*, is a town of England in Monmouthshire. It is situated on the river Avon, and consists of one long street running east and west, intersected by two smaller ones. The houses are in general small, but well built, and its numerous shops give a thriving aspect to the town. The parish church, which stands on an eminence about a mile from the town, is an ancient building, with a square tower at one end. This place derives its importance from the coals and iron which abound in its neighbourhood. Three forges are continually at work; and there is also a considerable manufactory of japan ware. A canal, communicating with Newport, has lately been formed close to the town. The population of the parish of Trevethan and township of Pontypool, in 1821, was 700 houses; 720 families; 225 families employed in agriculture; 395 in trade and manufactures, 2121 males, 1813 females, and a total population of 3931. See the *Beauties of England and Wales*. vol. xi. p. 104.

POOLE, a town, and county of itself, in England, and within the county of Dorset. It derives its name from the bay or pool on which it stands, and it is situated on a peninsula, three-fourths of a mile long, and half a mile broad, joined to the mainland with a narrow isthmus. The town consists of three or four considerable streets, running nearly N. E. and S. W. consisting chiefly of mean and irregular buildings, and these are crossed by a street parallel to the quay, at the east end of which is the Custom-house, the revenue of which has in some years amounted to £10,000. The church is an ancient building, with an elegant altar-piece, and consists of a body, two aisles, and a tower; and there are in the town, meeting-houses for Presbyterians, Quakers, and Anabaptists. The other public buildings are, the market-house, rebuilt in 1761; the town-hall, in Fish Street, with the prison under it, built in 1572; the great cellar, King's Hall, or Woolhouse, an ancient edifice, lately rebuilt in part; and the town-house, erected in 1717, by a company of merchants. There are also several schools, and a flourishing Sunday school. The trade of the place is limited chiefly to Newfoundland. The articles of export are provisions, nets, cordage, sail-cloth, wearing apparel, &c.; and the imports are, cod, salmon, oil, seal-skins furs, and cranberries. About 230 vessels belong to the port, amounting in burden to 21,801 tons, and employing 1500 men. The depth of water in Poole harbour is sufficient for a ship that does not draw more than fourteen feet of water. There is a considerable oyster-fishery here, which supplies London for two months with oysters. No less than forty sloops are employed; and the annual receipts are from £6000 to £7000. The sea ebbs and flows four times in twenty-four hours here, when the moon is at south-east and north-west, and more when she is at south by east and north by west. Poole is governed by a mayor, recorder, four aldermen, a sheriff, two coroners, two bailiffs, and eighteen common councilmen. It sends two members to Parliament, who are elected by 96 burgesses. The population of the town and county, in 1821, was 1108 houses, 1378 families, 1311 employed in trade and manufactures, 3014 males, 3376 females, and a total population of 9390. East Long. 1° 58′ 55″, North Lat. 50° 42′ 50″. See the *Beauties of England and Wales*, vol. iv. p. 409.

POONAH, a city, or rather large village of Hindostan, in the province of Bijapoor, and the capital of the Peshwa, and of the Mahratta empire. It is situated near the confluence of the Moota and the Moolu Rivers, about thirty miles to the east of the Ghauts, and though not fortified, it covers about two square miles of ground. The streets, which are named after mythological personages, are long and narrow. Several of the houses are large, and are built with square blocks of granite, to the height of about fourteen feet, the upper part being a frame-work of timber, with slight walls of brick. The houses of the common people are only one story high, with tiled roofs, and on the fronts of many are painted the history of the Brahminical deities. The ancient palace or castle is surrounded with high and thick brick walls, having a round tower at each angle, and only one entrance through a pointed arch. In one of the suburbs, called Sungum, on the opposite side of the Moota river, are situated the habitation of the British resident and his dependents; and near it are the cantonments for the subsidiary force. At the bottom of Parvati Hill, is a large square field, enclosed with high brick walls, where the Peshwa gives alms to the assembled Brahmins. To the eastward of the city there are many mythological excavations, similar, but superior to those of Carli and Elephanta. Population about 100,000. East Long. 74°. North Lat. 18° 30′.

Distinctions of the poor.

POOR. It is of more importance than at first sight appears to form correct views of the real poor. The word poverty is a relative term, the precise meaning of which depends on circumstances: and in England, for instance, the law has virtually applied it to all those who receive supplies as paupers out of the parochial rates, though many of these possess more of the means of subsistence and even of comfort, than others in different nations, who would spurn at the application of such a term to them. Indigence, applied to the necessaries of life, corresponds with poverty; but when it is not severe, nor of long duration, the sufferers ought not to be classed among "the regular poor." It may be no way degrading to persons incapable of supporting themselves, or of obtaining the means of subsistence, to be on this list; but to others who are able to labour for their own support, or who possess the means of obtaining the necessaries of life, without becoming what the law calls paupers, it is both degrading and pernicious to sink into that list.

Incidental supplies.

Absolute want of the necessaries of life is, indeed, the extreme of poverty; yet this may occasionally occur, either to individuals or to nations; and whether these be rude or civilized, without inferring habitual dependence on the bounty of the community. Many industrious families, and indeed the labourers of whole parishes, (with few exceptions) have required some temporary supply, in consequence of particularly unproductive seasons, in various parts of Scotland; but these families regained their independent character when the respective emergency passed away; and if they had not, the Scottish list of paupers would now be many times as numerous as it is. Severe times of dearth or scarcity, are often followed by extended poverty spreading, as one of their effects; but the temporary pressure of famine itself ought not to reduce its victims to the list of regular and habitual poor; nor should this list ever include those who merely require and receive only incidental supplies. This distinction, though not always correctly observed in Scotland, is yet better observed there than in almost any other country; the numbers requiring aid being few, and their wants more easily supplied; while the funds of charity are small, and must be distributed with due care; and while those who distribute them are not only able to understand correctly most of the claims, but have also either a natural or a moral interest in preventing extravagant and unnecessary supplies. In England, the distinction, though laid down in the law, was not made, in practice, correctly, and perhaps could not well be made by the persons to whom the execution was committed, previously to the year 1819, when a new mode of proceeding was authorized by statute, on improved principles, which has already been of considerable advantage, but still requires farther improvement.

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The state of the poor is diversified so much, that a detail of its varieties would lead into statistical investigations, far too extensive and elaborate for a work of this nature. That state is widely different in large towns from what it is in rural districts; it is different in England, from what it generally is in Scotland; and still more widely different from both in Ireland: there is a wide difference between the state of the poor in these united kingdoms, and that in which they are placed in other kingdoms in Europe, from Russia to Naples; the state of the poor in Asia and Africa, and within the several parts of each of these quarters of the globe, exhibits diversities even more remarkable. The poor of the metropolis of England are in a different state, in reality, from what appears in most other cities and towns; it has altered materially in Edinburgh, Glasgow, and other cities, of late; the northern and Highland parts of Scotland discover a state of the poor, in many respects different from what occurs in the central parts of it, where it also differs again from their state in the borders; the state of the poor in Scotland, at large, is very different from what it was in former times: in England, also, an important change has lately commenced, and is going on.

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It would be a task equally laborious and perplexing, to go through a particular detail of all these diversities in the state of the poor. Perhaps it is owing chiefly to the number and extent of these, compared with the corresponding diversities of the modes adopted for providing for them, and to the no less remarkable diversities of their consequences and effects, that the subject of "the poor," embracing all these, has been felt so exceedingly difficult. The causes of poverty have not always been well understood, nor even the very nature of it as an evil, nor the best means of alleviating its pressure: the modes adopted in one country do not answer well in some others; uncertainty leads either to neglect of the poor, or to injudicious modes of relieving them; and not unfrequently the most important virtues of industry and economy, and the most endearing virtues and ties of charity and gratitude which ought to unite and to sweeten society, are undermined by the injudicious administration of the poor's funds.

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It cannot be denied that such have been the results in practice, and therefore it is evident that in many respects that practice has been faulty. Entire neglect of the poor drives them to despair, and of course to acts of desperation and violence; laws and regulations having no object, except to silence or suppress their demands, are cruel, injudicious, and ineffectual. In the indiscriminate supply of all who ask, the most clamorous and worthless often supersede the most deserving and modest: if want be the sole measure of the supply, without regard to character, conduct, or consequences, temperance, industry, and economy are subverted; if right be admitted as the basis of the poor's claim, charity and gratitude are almost wholly excluded. In these and other respects, the practice may often be justly considered bad; and yet, without going into a detail of the many practical errors thus committed, some view of the correct principles of administration may be attained.

Moral influence of poverty.

If poverty were in all its bearings an evil, its total removal out of the world might be considered as a blessing. But though its pressure is always felt and viewed as an evil, its consequences are not always to be considered in this light. That pressure, with all its privations and sufferings, is a powerful stimulus to industry and economy. In its undefined, yet obvious tendency towards absolute want, it also excites our fears and our foresight; and thus, though an evil in its pressure on those who are subjected to poverty, and in the sympathetic views of the charitable who consider their sufferings, it is the instrument of preventing indolence and prodigality; and without the sight and the pressure of it, human society could hardly be maintained. These are not all the good effects which result from it; for poverty has often produced other happy moral effects, being favourable to temperance, chastity, and other virtues; nor are these enlarged on here, though in the habits of considerate and prudent foresight, and of industry and economy, as well as in their many and growing benefits, the individuals who cherish these habits are gainers, to a high degree, as well as the community in which they live.

It may therefore be laid down as a principle, that to banish poverty out of any community, would be a vain and inconsiderate attempt; and that its pressure ought only to be so alleviated, as not to subvert its useful influence on mankind. We may view it as one of those apparent evils which occur in society, as the sanction of habits and virtues necessary to its existence.

Extremes in management.

The correct principles of the administration of the funds of charity, have certainly not yet been generally understood; otherwise the practice would have been proportionally improved. Utter neglect of the wants of the poor is one extreme, which has a dangerous and obvious tendency to excite all the worst feelings of the poor, and to stir them up to violence against individuals, and to hatred and rebellion against the laws. The opposite extreme consists in making want, without regard to conduct, the measure of the pauper's claim; and in grounding this claim, not in charity but in right, for thus are the best principles undermined, both in the giver and the receiver, whose condition indeed becomes so changed, as not to admit of the correct application of the term pauper to one vested with right, and consequently with power to enforce this right at the expence of others. The sister kingdom of Ireland furnishes too many instances of a near approach towards the former extreme, and England towards the latter.

In Ireland.
In England.

Tendency towards errors in Scotland.

In Scotland, notwithstanding the rather boasted superiority of the general mode of administration, there is really a tendency towards both of these extremes. Many of the poor in the northern and Highland districts are so neglected by landholders and their men of business, as to be driven out into other parts of the kingdom as common beggars, or to fall as a heavy burden on the families near which they happen to reside; and no adequate provision is made for the general poor of some of the respective parishes. In the southern and border parishes, on the contrary, assessments are introduced, which, though commonly not excessive in a degree beyond the increase of land rents and population, and therefore not making an increasing burden, are yet so liable to become regular pensions, thus relaxing industry, or to be given under mechanical forms without sufficient attempts to discriminate, that great attention is required in order to render this mode of provision perfect; and, after all, it has the regular effect of diminishing the public charities of the people, including even those who are not assessed. In the central districts, and in some parishes, the landholders generally contribute what is wanting for the support of the poor, over and above the collections and other funds, without assessing; but here many heritors refuse, or neglect to give any thing; and the burden devolves with unequal pressure on the liberal, while others very improperly escape. There is also commonly another great evil throughout this part of Scotland, (which is not permitted in the border districts where assessments are made,) and which is caused by swarms of common beggars from all quarters infesting the country, and raising contributions, in amount often far exceeding what would support the poor of the district. These undeniable facts discover too evidently that the practical administration in Scotland is capable of great improvement. There is in reality a tendency towards ipmrovement; but certainly the most equal and efficient administration is in the way of regular assessment, notwithstanding the objections against it; nor is there any reason to dread that this mode should go to an extreme, while the dangerous example of the system in England is close in view; and the power is vested conjunctly in the minister and elders, who know the claimants, and in the landholders, who have an interest in preventing extravagant or improper grants. In point of fact, many of the parochial assessments are in the way of being gradually reduced. In the principal cities and towns of Scotland, a great deal more attention is now given to the claims and conduct of the poor; but the system of exclusion of all improper persons from these only drives them out into the country, where the practice of common begging has arrived at a great and burdensome height, and is really an almost intolerable evil.

Most regular mode by assessment.

Bad effects of common begging.

Perhaps this mode of supply by common begging is one of the very worst ways in which the poor are, or have been supported in any country; and yet it continues even in France, where the revenues of the state are sparingly applied in aid of the funds of charity. Under the old ecclesiastical establishments, largesses were distributed to crowds of beggars with little or no discrimination; and still, at this day, it is impossible to distinguish correctly among vagrants from all quarters, of whom nothing can be certainly known, who employ all the acts of fraud and falsehood, conjoined with the habits of idleness and low profligacy, and who are suffered to perpetuate these evils by training children in the same habits. England alone, and some of the border districts of Scotland, have got rid of this great evil; as in some degree an alleviation of the burdens entailed by assessment; and a great relief it certainly is.

It would swell this article too much to go into details of the management of the poor in other European states. We have laws in Great Britain to regulate this administration; and the statute laws are in principle similar in the two united kingdoms, though in most parts of Scotland the common law has established a practical and superior influence. An approximation is making in respect of administration, by the silent progress of statute law in Scotland, and by the new statute 1819 in England. In Ireland, it seems barely possible to go on, without some poor laws, for any length of time; but indeed better principles of economy ought to precede these, in order to give them effect. In other kingdoms and states, there is little to remark, and less to commend; only that the poverty, misery, and vice, which have overrun some of the finest and most fertile nations, are truly astonishing. And on this point it seems unnecessary to say more than merely to name France and Spain, Portugal and Italy; and to refer to the too well authenticated facts connected with the Poissards, the Sans Culottes, and the Lazzaroni. It is refreshing to cross the sea to the new world, to the United States, where land is in abundance, labour productive, industry almost unrestrained, and the condition of poverty seldom and little known.

General bad management in foreign states.

Causes of poverty.

The causes of poverty ought to be well considered, in order to arrive at any certainty with regard to the best and safest means of alleviating its pressure: now these causes may be either natural or artificial; and in some cases these may be conjoined.

Natural.

Among the labouring classes, whatever incapacitates from productive industry, may be the cause of poverty, such as befalls the blind, maimed, lame, aged, and persons under diseases of body or mind; and also persons burdened with the charge and support of others in any similar condition. These are, by the common consent of all nations, considered as "the poor;" and many seem to look upon these as almost the only persons entitled to be so considered. Accordingly, most of the lists of regular poor are made up of persons in such a state as these; and it is for persons in that state that provision is ordained to be made, under the statute laws of England, and Scotland also. They are what the people call "seen objects;" and every one admits that they ought to be supported, though it is not quite agreed upon what is the best mode of so doing. If the administrators of the poor laws of England had found it safe to confine the public bounty to such as these, no country in Europe would have been less pressed than England would now have been in maintaining its poor.

Accidental.

But other causes may and do operate in extending poverty, besides old age, diseases, and bereavement. One bad and unproductive season has reduced numbers of the labouring classes to poverty, and the subsequent years have distinctly shown that such has been the consequence; as may be too well established by referring to 1783, 1800, 1817, and other times of dearth and scarcity following unpropitious years. The last of these years was followed by a great want of labour; and the impoverishing consequences among labourers and tradesmen in many country districts are still felt among them to the present day.

Artificial.

Yet the many artificial causes of poverty are not commonly so well marked and understood, although their effects are equally, or even more extensive. We do not here allude particularly to the waste and ravages of war, though frightful; nor to governments founded in ignorance and tyranny, such as those of Turkey, the states of Barbary and Egypt, which have reduced to poverty and misery the inhabitants of some of the most fertile parts of the earth. Neither do we allude to those losses which occur in trade, nor to that misfortune, from which not even the most industrious are exempted, nor the most prudent. These occasional causes of poverty are neither uncommon nor unknown. But there are other causes which operate steadily, and to a wide extent, the consequences of which are less regarded; and even the causes themselves are often too little considered. These are want of employment, want of industrious dispositions and habits, and want of principles and habits of economy.

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Want of productive employment is the great cause of poverty in Ireland; and the influx of labourers from thence into Scotland has also rendered employment more deficient and less productive here for the male population: there is also a want of employment for children, and for females in Scotland, especially in winter, which is aggravated of late years by the abstraction into England of the manufacture of wool, in consequence of the incapacity of the people of Scotland for the most correct assortment of the raw material. In England, in general, there is employment for all classes, and both sexes; and, accordingly, there is less real poverty nearly in the same proportion in which employment is more abundant and productive, notwithstanding the great number of paupers. Yet, in England, the most productive and steady of all sorts of employment, the improvement of the soil, is allowed to remain under the triple restraint of entails, tithes, and rights of common. Entails in Scotland extend farther in time, and are therefore even more pernicious; but rights of common are easily divided, and all tithes are paid by the landholders, on a valuation made for each estate once for all. The fatal influence of these restraints in Ireland is too well known. It seems, indeed, not easy to account for the continued existence of such restraints on agricultural industry in these kingdoms.

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Want of industry would seldom be seriously felt or complained of, if that industry could find a suitable and unrestrained field of exertion, together with a corresponding reward. Commercial industry is indeed exposed to many interruptions in the laws at home, (which, however, have been relaxed by a more liberal policy of late,) and also in the jealous policy and rival interests of foreign states. Manufacturing employment is liable to vary according to the supply of raw materials, and the demand for produce; especially if that supply and demand be chiefly from foreign countries. When these branches of industry prosper, they afford a powerful stimulus and support to agriculture, which is the steadiest and most productive kind of national industry. The accumulated produce of the several branches of national employment exceeds calculation, and even baffles conjecture. Spain, with all its continued imports of gold and silver, and its rich soil, had become a poor country, through want of industry, long before it lost the foreign colonies; while the united provinces had become opulent. Ireland, though one of the finest countries in Europe, is one of the poorest, because the people want employment; and vice, ignorance, and prejudice are engrafted on idleness. Let Ireland be opened to unrestrained and productive employment, and let the soil of that kingdom and of England be relieved of the fetters of entails, tithes, and commons, by equitable laws; and it may safely be predicted, that by these measures, and by the abolition of entails in Scotland also, these united kingdoms will prosper beyond what they have ever yet done, and poverty will in proportion disappear.

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Want of economy is another cause of poverty, that operates to a wide and unascertained extent. Habits of luxury in their families above the station of common operative tradesmen and labourers, and of low debauchery in taverns and alehouses, have kept many of these from acquiring, during favourable times, what it was then possible for them to lay up, and would have rendered them in their station easy and comfortable. The want of proper modes of investment could not be pleaded, since the institution of that most valuable system of investment for the lower classes in savings banks; and though friendly societies were often calculated upon erroneous principles, in consequence of which they often disappointed those who had supported them, yet they did much good in the mean time, and contributed to form good habits. It will be seen hereafter, that suitable protection and encouragement have been granted by the legislature for both of these modes of investment. The want of economy, however, embracing all sorts of expensive extravagance, has brought many even of the higher classes of tradesmen to poverty. It has reduced many families of a station still superior to these; in consequence of ruinous and heartless emulation, founded in false taste for splendour and luxury, often in reality mean and selfish, but sustained by fashion; and the common way of expending most part or all of the fortunes of country gentlemen in the cities or the metropolis, has deprived great numbers of their dependents in country places of their accustomed means of subsistence.

Abstraction of land rents.

This last observation may serve to introduce another, illustrative of the poverty which has of late spread in rural districts of these united kingdoms. Most of the land rents being yearly abstracted and spent in the cities, and a constant drain of the remaining funds of these districts being kept up under the form of taxes, it cannot appear surprising that poverty should appear with increasing pressure; nothing but ample and increasing returns of land produce and rural industry could be calculated upon to meet and impede this pressure; and these having greatly declined of late, are quite inadequate to accomplish this end. It is indeed hoped that the low rate of interest now allowed may force the great capitals to a land investment, in part at least; and were men of capital to find it their interest thus to invest it, and could this be done without interruption of entails, they would probably also be liberal in improving. It is not for the general advantage of these kingdoms, either in respect of wealth or morals, to desert the country, and leave it in a state of desolation and poverty; while the funds of the nation go to swell the overgrown capital, and are there dissipated. The conduct of the mobs in Paris and the fate of France ought not to be forgotten.

Legislative inquiry and reports in England.

In order to obtain a correct and enlarged view of the state of the poor in England, the two houses of parliament named their respective committees of inquiry, whose reports were submitted in 1818. It then appeared that though the principle of the laws of that kingdom is good, founded principally on the consolidating act of the 43d of Elizabeth, and whose two main objects were to provide funds to support the real poor, and the means of employment for others destitute of work and yet able to labour; the administration by church wardens and overseers, under the eye of the local magistracy, had become so little discriminative, and so very extravagant, as to have raised the average numbers of the paupers for the years 1813, 1814, and 1815 to 940,626, being above nine in the hundred of the general population. For these it appeared that no less than L.6,132,719 were annually expended in maintenance; besides as much more for connected rates and expences, as to swell the total fund up to above eight millions sterling; entailing a burden yearly of above 16 shillings per head on the whole population of England and Wales.

Assembly reports in Scotland.

These reports were also connected with, and one of them embraced a view of the state of the poor in Scotland. The Earl of Hardwicke, chairman of the committee of the House of Lords, and Mr. Sturges Bourne, chairman of the committee of the House of Commons, on the subject of the poor, had severally addressed letters of inquiry to the Moderator of the General Assembly of the Church of Scotland, which were delivered at one of their sessions in 1817; and notwithstanding the doubt expressed by a Right Hon. elder, how far it became the dignity of the Assembly as the Supreme Ecclesiastical Court in Scotland, to take any steps in answer to these letters,—a committee was named with instructions to inquire and report. That committee selected a few of their number to whom this business was delegated, and who met every evening at the house of Sir Henry Moncreiff Wellwood, the convener; and, under his able direction, with the use of reports on the subject in the hands of the Hon. T. F. Kennedy of Dunure, M. P. and the personal assistance of Dr. Singer, a report was made up in the columnar form, containing most of the particulars wanted, along with the population in 1811, and embracing about one hundred parishes out of the various districts of Scotland, which report was delivered in, within about a week after its commencement. This first attempt was highly approved of; and the Assembly reappointed their committee, the very reverend Principal Baird to be convener, with instructions to extend their inquiries throughout Scotland. Queries were framed for this purpose, and returns obtained in 1818 from above seven hundred parishes, the result of which was embodied in the report made up and submitted by the convener in 1818, and soon after published. A vast mass of useful and valuable information was thus obtained, which occupied Principal Baird's willing and patient attention for several months in digesting; but owing to the multiplicity of the reports, and the great extent of matter embraced in them, with other circumstances, a very considerable number of errors appeared in the first edition in 1818, and it became necessary for the subsequent assembly to recall the committee's attention to the whole report, that it might appear in a more correct state. After all, this report, though it may be capable of farther improvement, will be an interesting work as it now stands to future ages. Some very interesting facts were established from these reports, compared with other sources of information. The regular poor in Scotland are only about one in the hundred of the population; the persons incidentally assisted are nearly two in the hundred, including extra provision after unpropitious years; and the sums applied in aid of the whole, (in number about 30,000,) somewhat exceed a hundred thousand pounds, of which above two-tenths are collected at the church doors, about five-tenths consist of accumulated funds and voluntary grants by heritors and others; and not quite three-tenths are assessed, though this mode of provision is now adopted in above 150 parishes. The proportional supplies for each of the regular poor in the assessed parishes towards the borders, (now in the course of reduction) cannot be stated at present above £5; in the central districts £3; and in the remote northern and Highland districts not much above £1, at an average, not including incidental supplies or emergencies only, nor the sums collected by common beggars. In the cities of Edinburgh and Glasgow, the regular poor are not very far from one in the hundred, but the incidental lists rise to three or four in the hundred according to circumstances, and the rate of expence for each of the regular poor may be stated somewhere about £8, and each of the others about £3. Most of the Scottish poor do somewhat for their own support; and those on the lists of incidental supplies are merely assisted with small occasional grants in aid of their own efforts.

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The state of the poor in France became a national object during the time of the Revolution; but there, as well as in Italy, there is no compulsory provision; mendicity is allowed to a great extent; there is a want of employment in winter; and though much attention is given to promote and apply the public charities in France, the numbers of poor are considered as rising to one-fifteenth of the population in rural parts, to one-tenth in the towns, and to one-seventh in Paris, the capital. It is believed also that one-third of the burials in that city are at the public expence. It is impossible to ascertain the precise numbers and state of the poor in those nations where servitude still attaches them to the soil, devolving the burden of their support almost wholly on the will and humanity of their lords; and the same remark applies to countries in which slavery still remains.

With respect to the state of the poor in Ireland, and also to their vast numbers, every report as to both is melancholy indeed. In the labours of agriculture they have little encouragement, being so extremely depressed under the system of holding, which entails on them enormous rents, and also by the tithe-system, that sweeps away a great part of the produce. In manufacturing industry, and in commerce, though they have partly succeeded in some branches, yet in others they have not been much encouraged. Capital is wanting; and owing to habits of riot and insubordination, few men of capital are willing to embark it among the people of Ireland. The great mass of the lower classes is in abject poverty; and their numbers are far more than the proportion in any country yet mentioned, or perhaps in any country whatever.

Principles of poor's laws.

It would be vain to attempt to construct a good system of providing for the poor without a proper basis of facts and principles. The facts above detailed are interesting and valuable; but the more important part of this article still remains, to state the legitimate principles of provision for the poor, and of administering to their necessities.

Legislat measures.

In order to provide for the wants of the poor, it is commonly necessary to have recourse to the highest authority, that of the legislature; and this authority may be exercised in two ways, in removing obstacles to full and free employment, associated with habits of industry and economy, or in making some positive provision for their support out of specific means and funds. The latter mode is what occurs generally as the first and readiest, though it requires a degree of prudence and delicacy which few laws have yet attained. The former is the more correct and effectual mode, as it not only serves the poor in the way most grateful to their feelings, and most consonant with good principles and habits, but also tends to prevent the increase of poverty in the community. It may be proper to notice a third way, that of setting loose the poor on the community as common beggars, in order to extort alms by importunity, or by other methods less or more nefarious, but all tending to propagate idleness, imposture, and low profligacy over the country. This last mode is so pregnant with evils, that it appears astonishing how any enlightened legislature should deliberately tolerate it, however it may have been introduced by temporary pressure and abuse, or want of means to meet it.

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In the first mode of providing for the poor by legislative authority, we have stated that obstacles to full and free employment should be removed, and habits of industry and prudence encouraged. In the 43d of Elizabeth, the legislature of England had this important object in view; but they seem to have apprehended it very indistinctly, committing the authority of executing it to men who had not, and could not have sufficient means or influence; and still this indistinct apprehension continues. It was not in the power of the church-wardens and overseers of the poor, even under the authority of the law, and with the support of the magistracy, to make effectual provision for full and free employment; it never can be in their power to do this, with all the improvements lately made by law in their administration. The greatest and most productive source of employment is land; and so long as the land is locked up by entails in the hands of persons having neither due motives nor sufficient means to cultivate and improve it, one most important branch of employment must continue shut by law. The rights of common, which in England require the authority of individual acts of parliament, in order to explain them, and to confer on individuals their several ascertained and improveable interests, ought long ago to have been placed under the influence of one general and equitable bill of enclosure, and thus employment and subsistence for thousands would have been at once attained. Above all, the tithe-system, which admits of one general and equitable commutation in the form of a valuation made once for all, as exists in Scotland, requires to be revised, that encouragement may be given for the best and most productive employment, on a great national scale. These measures can only be taken by the legislature itself; and it is only trifling with the great interests of the community, to leave them as they are unattempted, and the proper employment of millions in triple fetters, while nominal powers (quite ineffectual) are continued to a few individuals, in order to find or to force employment. The true policy of the legislature is here quite apparent; and it ought to be extended in full influence to Ireland, and also to Scotland, in so far as concerns deeds of entail. To these measures, the united kingdoms must at last have recourse; and the sooner they do so the better. Scotland has prospered under the valuation of her tithes, and the fair and easy mode of dividing her commons. Ireland would be still more a gainer by the former plan, which would obviate half of the heartburnings that cause her misery; and landholders, though subjected to payment of tithes, would be soon more than indemnified in rents and improvements, with security and peace. The wise and liberal policy now adopted, in respect of commercial and manufacturing industry, tending also to relax the restraints imposed by the jealousy of other states, must eventually open a wider field of employment in these great interests, and will of course materially add to the prosperity and efficacy of agricultural industry and employment also.

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Then what new fields of employment must open in all the trades and arts connected with, and subsidiary to agriculture, manufactures, and commerce! It is not possible to conceive what effects a liberal, enlarged, and wise system of legislation like this would produce. Most of the paupers capable of employment would soon find it, according to their own choice and circumstances; and ample means and funds would then be obtained for the easy and comfortable support of the real poor. The improvement of land would be general and great; and the benefits would not only fill this land, but extend their happy fruits and effects to our colonies and to remote nations. Our now restrained use of capital would then become free and general; and the mutual interests of the owners of it, and of the labouring classes, would soon be adjusted in the full employment of capital and people.

Specific
funds of
provision.

The latter mode of providing for the real poor out of specific funds to be allotted for the purpose, might then be adopted and put in force with comparative ease. The poor would not be in such oppressive numbers; a portion of employment might be found, as in Scotland, for many or most of them; and the public would be more able and willing to support them. After all, the true principle of maintaining the poor might still be preserved in considerable purity by voluntary charity; not only in the way of donations and collections for them, but also in the supplementary provision to be made by assessment.

Error in
principle in
43d of
Elizabeth.

Improvement by
select vestry act,
1819.

The act of Elizabeth was erroneous in principle, in committing the power of assessment of sums to an undefined extent to a few men, having no adequate interest in a correct discrimination, and in preventing excess and abuse. It was not indeed foreseen by her wise counsellors how inefficient the powers of these men would ultimately prove in finding work for those who could not themselves find it; nor how burdensome the subsequent interpretations of this part of the statute would prove. The new act, 59 Geo. III. c. 12. to amend the laws for the relief of the poor (31st March, 1819) has committed the formidable power of assessment to select vestries, approaching to the nature of the meetings of heritors and kirk sessions in Scotland, and possessing an interest in keeping down the amount, and also in bestowing the sums assessed with proper attention and discrimination of character and conduct, as well as real need. Emergencies are provided for under this act; but such provision as magistrates are authorized thus to make, is to be grounded on the oath of the claimants, and to have effect only for a short time; and relatives are bound to support their needy parents or children if they possess funds. A great deal of good has been already silently attained under this excellent statute; which provides by law for the real poor, yet interferes as little as possible with the proper exercise of prudence and charity.

Acts in
favour of
savings
banks and
friendly
societies,
both in
1819.

In addition to this wise enactment, the British legislature, in the same year, passed the two statutes; one for the protection of banks for savings; the other for the farther protection and encouragement of friendly societies (59 Geo. III. ch. 62 and 128) evidently intending to give their continuance to proper habits of industry and prudent economy; and thus to enable the labouring classes to make honourable provision for themselves and their families, in the safest and easiest manner. The former act applies to Scotland, where it has already been of very great use; and the latter to the united kingdoms.

Farther
improvements
obviously
wanting.

After such enlightened and laborious efforts already made by the legislature of Great Britain and Ireland, for improving the laws and the circumstances of the poor, it is hardly to be supposed that by far the greatest and most hurtful restraints on their industry will be suffered much longer to remain, however consecrated by antiquity the system of tithes drawn in kind, entails, and rights of common may now be.

Collections of dissenters.

It may be considered of minor, yet it is not of small importance to remark, that all dissenting congregations ought either to apply their collections to the maintenance of their own poor, or to put in the whole, *bona fide*, among the funds of the parish poor without distinction; and it may seem to have escaped the notice of the legislature, but it was placed by a special application in the view of the board of treasury, that legacy duty is exacted for bequests made in behalf of the poor, and no exemption granted.

Cottages.

Poor tenants.

Education.

The tenure by which the poor hold their cottages and small allotments of land, is by far too short and uncertain at present; and unfeeling or capricious landlords, or their agents, expel them frequently and force them into the towns, where their health and morals, together with their comfort and usefulness, are all impaired, and many rural districts are left in a state of desolation. It ought to be in the power of landholders to remove either tenants or cottagers at the end of their respective contracts or leases; but far longer previous notices ought to be given them, and perhaps also a reasonable compensation for improvements to which they were not bound, and of which the landholders at their removal enter into the fruits. There is also a degree of distress attending general removals of bodies of tenants and their families, and thus throwing them on the public in a state of want of employment and subsistence, for which there is no remedy in the present law; but for the necessity of some ameliorating act, the many removals of bodies of people, which have even of late occurred in Scotland, the interests of humanity, and the dictates of public justice and policy appear to plead. Connected with this humane and wise attention to the state and feelings of poor tenants and cottagers, is that which is due to the education of their children, especially in remote situations. This object, in many of the vast parishes of Scotland, is evidently impracticable by one school and teacher; and, therefore, under the new act, 1803, two parish schools are in some cases allowed; but a clause was permitted to be inserted in this case, relieving the heritors of all obligations to build or uphold the teachers' dwelling-houses; which in effect was to render the above allowance of little use, and the accommodation it conferred of rare occurrence.

Residence of the poor.

In addition to these matters, which cannot be remedied without legislative authority, and are yet of great importance to the comforts, the usefulness, and the loyalty of the poor tenants and cottagers of Scotland; it is believed that few things would be of more essential service to the real and deserving poor, than a more vigorous enforcement of residence and prohibition of common begging; and a stronger call on the heritors and kirk sessions of remote parishes to give correct and regular attention to the state and wants of their own poor; to attend to their employment also, and to recommend and enforce the duty of industry in their own parishes, prohibiting the too common practice of wandering as mendicants.

Perhaps in return for any information collected in Scotland, and communicated to the two houses of parliament, this generous attention to what is most in need of remedies in the laws and practice of Scotland, relative to the poor, might be viewed as worthy of the legislature of this enlightened kingdom.

Ireland.

With respect to Ireland, until the field of productive industry has been fairly opened for the labouring classes, it appears difficult to suggest any thing likely to improve the state of her innumerable poor. But if the tenure by which land is held were duly improved, and land itself, as a subject of improvement, cleared of tithes in kind and other fetters; and then if capital were employed in commercial and manufacturing industry, with liberal attention to the state of the people; and if the children were trained in habits of good conduct, and educated so as to qualify them for greater usefulness, the next generation might see Ireland advancing with a rapid and steady pace towards comfort in its own population, and kindly and beneficial influence as one of these united kingdoms.

France.

The legislature of France has rejected all assessments for the poor, and sanctioned common mendicity over the land. The despotic governments of other nations appear slow and reluctant in giving their people emancipation from a state of servitude. Little hope of amelioration for the state of the poor in these nations appears therefore at present. Perhaps it is reserved for this island to give the tone and example in this great branch of policy and humanity, as it has done in the abolition of the trade in slaves, and the propagation of religion over the world. The United States of America have evinced both a liberal and profound policy, in providing for the poor already, by allotments of land, even before their state of population and society had arrived at such a point as to bring this burden into existence.

Widows' fund societies, and for life assurance.

The numerous widows' fund societies now established in Britain, and the companies formed for life assurance, have produced great and beneficial consequences in warding off poverty from individuals; but perhaps the attention of the legislature is more wanted in order to watch over these institutions, and to render them safe depositories of the public contributions, than has yet been given to them; or than any other public institution of the present time now requires.

Suppression of mendicity.

Attention to the wants of the real poor.

In order to administer to the necessities of the poor on correct and legitimate principles, it may be stated negatively, that common begging ought at once and entirely to be suppressed throughout the whole of Scotland. A moderate and seasonable degree of attention on the part of the several ministers, is quite sufficient to draw the conjunct attention of heritors and elders; and if this were generally and simultaneously done, and passes given to convey the poor to their own parishes, the whole arrangement might be rendered effective in less than a single year; and it might then easily be kept in that state. The funds of charity would then fall of course to be first applied; and so long as landholders in general agreed voluntarily to put in what was necessary in supplement, no assessment could be necessary. This, however, though the last resource, might still be so managed, as to be attended with very little harm; and it is the only and the legal instrument for compelling those who neglect the poor to attend to them. Some wanderers indeed have no right, or pretend to have none, in any particular parish; but these might be accommodated in work and poor houses; and Scotland would then be cleared of a pest that has annoyed and oppressed her since the union of the kingdoms, and probably long before it.

The slow but steady progress of assessment on this plan, if accompanied by relief from the nuisance of common begging, would in fact be advantageous to the community; and also to the interests of the poor, and to the labouring classes of Scotland, as well as to landholders.

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It has been found that sheriffs have no right to interfere with kirk sessions and heritors in making up their lists of poor; and also that children able to assist in supporting their indigent parents, are bound in law to do so. These decisions are of great importance in ascertaining the true and good principles of Scottish law, founded in the spirit of charity and of duty. It cannot now be considered as either hard or imprudent for ministers to employ their legitimate authority in behalf of the poor; it is their duty to do so, and they are answerable to God and their country for the discharge of it. No prudent or liberal heritor will or can refuse his proportion; for if not voluntarily granted, it can easily be enforced, and on such principles as can be hurtful to no one.

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In the mean time, while a better system of administering to the wants of the poor is in progress, and the practice of Scotland and England are approximating towards each other, with the principles of law and practice in both kingdoms; it must be of great importance, while residence is thus enforced, to see that the poor are not destitute of employment. In former times, the manufacture of wool occupied many of the females during the dead season, as it has been called; and if this be now carried away into England, it might be so far recovered by the use of persons trained correctly to assort the Scottish fleece; after which it can be worked up to advantage.

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Many of those who administer to the wants of the poor, do so always, or for the most part, by distributing money alone. It would often be far better to give less money, and other necessaries,—as oatmeal, or coal, or perhaps cloth, or wool, or flax; or implements of industry, such as wheels, heckles, or combs. The Board of Trustees at Edinburgh now give aid in erecting carding mills for wool, and in bestowing heckles for the working of flax; and it must be a very particular situation indeed, where the minister, elders, and heritors, cannot materially contribute to the maintenance of the poor, by stimulating, assisting, and rewarding their industry. With a permanent burden of only about one regular pauper in the hundred of her population, Scotland may surely find useful employment for the other two incidental claimants on her kindness and bounty, and may grant what is necessary in supplement without a grudge. The law has now clearly said, that no annoyance shall be given in any inferior courts to ministers, elders, and heritors, in making up lists, and finding provision for the poor; and that no appeal from them shall be competent, except to the Supreme Civil Court of Scotland. The voice of duty, therefore, calls upon them, in connection with the dictates of humanity, of justice, and of good policy, not to neglect nor desert what is thus committed to them as a high trust, and which the principles of Christian charity render sacred.

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Females of high rank and accomplishments now appear at the head of many beneficent plans for the instruction of children, and the support of the poor, in various parts of Scotland. The co-operation of these will not be wanting to the minister and elders, if properly asked; and it will tend at once to sweeten their labours of charity, and to ensure their success. K. K.

POPAYAN, one of the provinces of the viceroyalty of New Grenada, in South America, bounded on the north by the Llanos de Neiva, on the east by Quixos, on the south by Alacamo, and on the west by Choco and the Pacific Ocean. It is about 128 leagues long, and 100 wide. The central and the highest branch of the three parallel chains of the Andes run through the province. The soil produces grains and fruits in abundance; and numbers of horned cattle, hares, and sheep, are reared by the farmers. Cattle and mules are exported to Quito, and clothes, &c. are received in return. Dried beef, salted pork, tobacco, lard, raw cotton, &c. are sent to Choco and other places in exchange for the precious metals; and sugar and snuff are imported from Santa Fé. The exchange of silver for gold is also a great branch of traffic, the former being scarce, and the latter plentiful. The character of the climate is that of a continual spring, and there is no other distinction between summer and winter than that the rains are less abundant in June, July, and August.

POPAYAN, the capital of the above province, is situated on a large plain, 5905 feet above the sea, and on the east side of a mountain of moderate height, called M, from its likeness to that letter. There is a convent of barefooted Carmelites on a spacious plain near the top of this mountain, from which issues a river that runs through the city. The river is called Del Molina, and is crossed by a stone and a wooden bridge. The town is built in a square form, and the streets are broad, straight, and level. Many of the houses, which are built of unburnt bricks, are handsome. The Dominicans, Franciscans, and Augustines, have all churches. The cathedral was endowed in 1547. At the royal mint, established here, a million of dollars are coined annually. Population about 25,000, according to Ulloa, though others call it only 8000. West Long. 76° 39′ 54″, and North Lat. 2° 26′ 18″.

POPE, Alexander, a celebrated British poet, was born at London on the 8th June, 1688. A short time after the Revolution, his father, who was a Roman Catholic, and attached to the exiled family, left the profession of a hatter, which he carried on in the Strand, and retired to Binfield, in Windsor Forest, where he had purchased a small house and a few acres of land, and where he lived frugally on a capital of £20,000, which he had acquired in business. Under his father's roof, and with the assistance of an aunt, he acquired the elements of learning, and he learned the art of writing by copying printed books. About 1696 he was placed under the care of one Taverner, a Romish priest, in Hampshire, for the purpose of acquiring a knowledge of the Latin and Greek languages. Soon after this he was sent to a Roman Catholic seminary at Winchester, and next to a school at Hyde Park Corner. He displayed an early talent for writing verses; and having met with Ogilvy's *Translation of Homer*, and Sandys's *Translation of the Metamorphoses of Ovid*, he studied them with ardour, and ever afterwards exhibited the most decided passion for poetry. When at the school at Hyde Park, he had occasional opportunities of visiting the theatre, and he was thus led to draw up a kind of play from Ogilvy's *Homer*, eked out with his own compositions, and which was acted by his schoolfellows, the character of Ajax having been performed by the master's gardener.

At Binfield, to which he retired at the age of twelve, he became acquainted with the writings of Spenser, Waller, and Dryden, for the last of whom he always cherished a special veneration. He once succeeded in obtaining a sight of Dryden at a coffee-house, but never became acquainted with him, a misfortune which his phrase of *Virgilium tantum vidi* so happily expresses. At the age of twelve he composed his *Ode to Solitude*, which, though a respectable early composition, exhibits no peculiarity of poetical talent. His translation of the *Thebais*, and of *Sappho to Phaon*, executed when he was only fourteen years of age, evince great progress in his career, and the last has been especially admired. At the age of fifteen he began an epic poem, called *Alcander*. A long time afterwards he showed it to Atterbury, and mentioned his intention of burning it. His friend concurred in the justice of the sentence, but proposed a mitigation of punishment, by saving "the first page, and placing it among his curiosities." "There was a time," says Pope himself, "when I was in love with myself; and my first productions were *The Children of Self Love upon Innocence*. I had made an epic poem and panegyrics on all the princes, and I thought myself the greatest genius that ever was. I cannot but regret these delightful visions of my childhood, which, like the fine colours we see when our eyes are shut, are vanished for ever."

The manners and conversation of our author were probably of the same early growth as his poetical talents. Before the age of sixteen he had attracted the notice of Sir William Turnbull, and had even formed an intimacy with him. His acquaintance, however, was now greatly extended by his *Pastorals*, begun in 1703. They procured him great reputation, and were the means of introducing him to Walsh and Wycherley, and some of the other wits and critics of the age. The Pastorals were printed in 1709, in Tonson's *Miscellanies*, and, though deemed by some deficient in original observation, were yet unusually extolled for the melody of the versification, and the splendour of the diction.

The genius of Pope was now destined to shine in a still higher sphere. He had already composed his *Ode for St. Cecilia's Day;* and in the year 1708, before he had reached his twentieth year, he wrote his *Essay on Criticism*, which, without being strongly marked with an imaginative lustre, evinced a maturity of intellect, and a knowledge of human character, that has rarely been surpassed.

His *Elegy on an Unfortunate Woman*, which he wrote in 1711, has been reckoned one of his finest compositions. The story is a mysterious one; and though the author had already shown that he was not under the influence of a romantic passion for the other sex, it has been supposed, without any reason, to refer to some lady who had inspired him with a real passion.

The publication of the *Rape of the Lock*, in 1712, stamped his reputation as an inventive poet. This mock heroic poem had its origin in the conduct of Lord Petre, who cut off a lock of Mrs. Fermor's hair; and, what seldom happens in such cases, it had the effect of reconciling the parties which that incident had placed at variance.

About the same time, Pope published his *Temple of Fame*, altered from Chaucer, and written two years before. In 1713, he published his *Windsor Forest*, the first part of which had been composed in 1704.

Pope now ventured on an undertaking of great difficulty and boldness. In 1713, he circulated proposals for publishing by subscription a translation of the *Iliad* of Homer. This project succeeded beyond his most sanguine expectations, and the rise of the subscription to £6000, besides £1200, which he received from Lintot for the copyright, ensured to him an ample remuneration for the labour which such a great work necessarily entailed upon him. He therefore proceeded with his translation with equal ardour and diligence; and he produced the first volume, containing the first four books, in the year 1715. Soon after the appearance of this volume, a rival translation by Tickell was published; and as Addison had now quarrelled with Pope, the public, who were not acquainted with the great ability of Tickell, with some reason, ascribed the work to the pen of Addison. Enraged at this attempt to injure his commercial interests, which was in no respect an honourable one, Pope attacked his rival in a piece of keen satire, which extinguished all farther opposition, and left him in full possession of the Troad.

With the produce of his subscriptions, Pope purchased his house at Twickenham, which afterwards became so celebrated; and he removed to it in 1715, with his father and mother. His father lived only two years to enjoy the prosperity of his family; but his mother long survived, cheered by the most affectionate kindness and attention of her son.

Thus elevated in society by the successful exercise of his own talents, Pope devoted himself to the improvement of his fortune; and having done much for his reputation, he began to do something to promote his comfort and establish his independence.

With this view, he published in 1717 a collection of his separate works, in one volume quarto, to which he prefixed a well-written preface; and he began an edition of Shakespeare, which was published in 1721, in a splendid form by Tonson, but which exposed him to much severity of criticism.

Having completed the Iliad in 1720, he now undertook a translation of the Odyssey; but feeling, no doubt, that independence had weakened his habits of hard labour, he engaged Broome and Fenton to assist him in the undertaking, for the sum of £500. This work was published in 1725, on the same condition as the Iliad, with this difference only, that Lintot gave him only £600 for the copyright. Twelve books of the Odyssey were translated by Pope himself, and the translation is marked by his able hand; but the other twelve, executed by his assistants, were, notwithstanding all his corrections and amendments, of a very inferior character.

In the year 1721, our author published a selection of the poems of his deceased friend Parnell, which he dedicated in a poetical effusion to the Earl of Oxford, who had retired from the disputes and cares of a statesman; and some years previous to this he had composed his "Epistle from Eloisa to Abelard;" a poem of singular beauty, but more strongly marked with the licentiousness than with the romance of love.

Soon after our author had settled himself in his elegant residence at Twickenham, he became acquainted with Lady Mary Wortley Montague, whom he had induced to reside in the village of Twickenham, in the house of Sir Godfrey Kneller, a lease of which he had contrived to negotiate for his friend. The poet ventured to address this eminent individual in the style of a lover; and this tone of intimacy was probably permitted by Lady Mary, on the ground that there was no risk of scandal with a poet, and especially with one of his personal disqualifications. The poet, therefore, carried on an intimate correspondence with her during her residence abroad; but on her return to England, various circumstances, both of a personal and political nature, of which we have given a detailed account in her life,[*] excited between them the bitterest enmity.

In 1725, our author was associated with Swift and Arbuthnot, in the publication of a volume of miscellanies, chiefly of a humorous kind. In this work he inserted a treatise on the *Bathos*, or art of sinking, in which he illustrated his ironical precepts by examples, and gave a classification of bad poets. As various living authors were distinctly ridiculed in this work, he created by it a herd of enemies, who attacked him by a species of abuse, which, though pushed beyond its salutary limits, could not be considered as altogether unmerited.

The war in which he was thus plunged by the inferior wits of the day, seems to have induced him to compose his *Dunciad*, which appeared in 1728, with notes by Swift, under the name of Scriblerus; the object of which was to overwhelm all his antagonists with ridicule. Many of the individuals thus brought into notice would have sunk into the oblivion which time soon provides for slender and presuming intellects, but the enmity of their great antagonist has raised them to a species of immortality, to which they were scarcely entitled. Although this work is often stained with coarse invective and offensive raillery, yet it seems to have been composed and polished with a degree of care that is not suited to a piece of personal and temporary satire. Even Cibber, who is the hero of the work, has declared that nothing of its kind was ever more perfect.

Bishop Atterbury is said to have encouraged our author in the exercise of this dangerous habit; and it seems to have been so congenial to his disposition, that he was unable to restrain himself from introducing it, even when he could not plead the apology of a provocation.

In an *Epistle on Taste*, printed in 1731, he is supposed to have ridiculed, under the name of Timon, the Duke of Chandos, to whom he had been indebted for many acts of kindness; and though he exerted himself in an attempt to repel this accusation, yet the public held him guilty, and did not abate the indignation with which they had visited him previous to his defence.

Some time before the appearance of his *Dunciad*, our author had nearly lost his life when returning home in the chariot of a friend. In approaching a bridge the carriage was overturned and thrown into the river. Being unable to break the glasses, which were up, he would infallibly have been drowned, had not the postillion broke them, and dragged the poet in safety to the bank. He was, however, so severely cut in the hand, that he never recovered the use of two of his fingers.

Having displayed in the *Dunciad* the highest species of talent, Lord Bolingbroke urged him to direct his attention to moral subjects, for which his peculiar powers seemed to be so admirably adapted. Lord Bolingbroke is said to have furnished him with the materials; and in 1729, he was fairly engaged in his *Essay on Man*. Bolingbroke, in a letter to Swift, tells him, that Pope's only complaint against the subject is, that he finds it too easy in the execution; and Pope, in writing to Swift, remarks, that the work of which Lord Bolingbroke has spoken with so much partiality is a system of ethics in the Horatian way. This work, which may be placed at the head of ethical poems, exhibits a most singular faculty for reasoning under the shackles of verse, and is distinguished by the energetic brevity of its style, by the condensation of its sentiments and ideas, and by the exuberant beauty of its poetry.

The success which attended his productions, seems to have induced him to publish his "Imitations of Horace," his "Moral Epistles and Essays," and other works of a moral and satirical cast.

So early as the year 1727, some juvenile letters from Pope to a Mr. Cromwell, "a pedant and a beau," who had been one of his early friends, were surreptitiously published; and some years afterwards, Curl the bookseller, published another collection of letters, put secretly into his hands, that had passed between Pope and several of his friends. Though Pope virtually denied all connexion with this work, and carried his anger to such an apparent height as to have Curl summoned before the House of Lords for a breach of privilege, in publishing some letters from noblemen in the collection; yet posterity seems to have fixed upon him the odium of contriving the whole plan in order to obtain some plausible reason for publishing a new edition. This edition accordingly appeared in 1737, in quarto, by subscription; and the work has been always deemed a great acquisition to our epistolary literature.

Pope had now risen to wealth, and to all the consequence which a combination of wealth and talent never fails to secure. Many of his most intimate friends composed the court of the Prince of Wales, who was then in avowed opposition to the measures of his father's ministers. The prince honoured him by dining at his house; and the poet was disposed in return to support the political measures of his illustrious guest. Under the influence of such patronage, he wrote his last two satires, entitled, *Seventeen Hundred and Thirty-Eight*.

In the year 1742, Pope gave to the world a fourth book of the *Dunciad*, the object of which was to ridicule useless and frivolous studies; and in 1743, he published the whole poem complete, as a specimen of a more correct edition of his works, in which he had made some progress; but which he did not live to complete.

His bodily debility was accompanied with a weak state of health, and a constitutional attack of headache, increased by a dropsy in his heart, indicated some approaching change. His friend, Mr. Hooke the historian, whom he had converted to Popery, saw that his disease was mortal, and requested him to receive the last sacrament. Pope replied, that though he did not think the ceremony essential, yet it was proper. Soon after this religious act, he became very ill, and he expired on the 30th May, 1744, in the 56th year of his age. He was interred at Twickenham, where a monument was erected to his memory.

By his will, which bore the date of December 11th, 1743, he bequeathed the liferent of his property to

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[*] See Vol. XIV. p. 660.

Popery. Population.

Miss Blount, and the property of all his works to his friend Bishop Warburton, who evinced his gratitude by publishing a complete edition of the whole in 1751, in 9 vols. 8vo. An able *Essay on the Genius and Writings of Pope*, by Dr. Warton, appeared, in 2 vols. 8vo. in 1756 and in 1782, and it was subsequently reprinted in 1806.

The character of Pope, though generally understood, has yet been depicted in rather various colours. From the state of his health, he required indulgences and accommodations which the possessor of a robust constitution is too apt to stigmatize as foibles; and, from the same cause, a fretfulness of disposition, and a shortness of temper, which were not indigenous to his powerful mind.

According to Lord Orrery, "his manners were delicate, easy and engaging; and he treated his friends with a politeness that charmed, and a generosity that was much to his honour. Every guest was made happy within his doors; pleasure dwelt under his roof, and elegance presided at his table."

On the other hand, Dr. Johnson observes, "his parsimony appeared in petty matters, such as writing his compositions on the backs of letters, or in a niggardly reception of his friends, and a scantiness of entertainment. He was full of his fortune, and frequently ridiculed poverty; he seems to have been of an opinion, not at all uncommon in the world, that to want money is to want every thing. He was proud of his connexion with the great, and boasted that he obtained their notice by no meanness or servility. He was capable of generous and elevated sentiments, and had a dignified regard to his independence. Inflexible in his dislikes, he was firm in his attachments; and Bolingbroke testified of him, that he had never known a man who had so tender a heart for his particular friends, or more general friendship for mankind. As a poet, admitting that he was deficient in invention, his claim to preeminence on other qualities will scarcely be disputed; and it will be generally admitted, that no English writer has carried farther, correctness of versification, strength and splendour of diction, and the truly poetical quality of adorning every subject that he touched."

POPERY. See the article Ecclesiastical History, Vol. VIII. Chap. II. p. 307, &c.

POPULATION is the state of a country with respect to the number of its inhabitants. The general principles of population have already been discussed under the head of Political Economy in this volume, and the latest returns of the population of the different kingdoms in the world will be found under their respective names.

As a new census of England, however, and of the United States of America, has been taken since these articles were printed, we shall insert under the present head the new results, and various other important particulars which could not have been previously given in this work.

POPULATION OF ENGLAND.

Population of England.

The following Table, given in the population returns by Mr. Rickman, contains a most important summary of the returns for 1700, 1750, 1801, 1811, and 1821. It is accompanied with the following explanatory remarks.

Col. 4 & 5. The population of Great Britain in the year 1811, as here ascribed to the several counties, is less by 243,000 than in the Table formerly given, not more than two-thirds of the army, navy, &c. at that time being supposed to be natives of Great Britain; the other third part of the army and navy being attributed to Ireland and foreign countries, and a majority of the seamen who then navigated registered vessels. On these considerations no more than a thirtieth part was added to the resident population of each county for its share of the army, navy, &c. and the same proportion is continued backward in the preceding columns, 1, 2, and 3.—But to the resident population of Great Britain in the year 1821, no more than a fiftieth part is added, the army and navy having decreased since 1811. This tends to lessen the per centage increase ascribed to the several counties, between the years 1811 and 1821.

Col. 6.—The area of the several counties of England and Wales, in square statute miles, is here given as measured upon Arrowsmith's large map, (date 1815-16) which being founded on the trigonometrical survey, is little liable to future alteration; and the measurement of it having been accomplished by means of an actual division of the surface into square miles, scarcely admits of error as to the area of England and Wales; nor would the area of each county be less accurate supposing its detached parts to be all known. Of such irregularities, fifty-three have been taken into account in these calculations, and those which remain undiscovered, are presumed to be of inconsiderable dimensions, though perhaps not few in number. Most of the detached parts are assessed in the county wherein they are locally situate. To convert the English square mile into a measure applicable to the maps of all civilized nations (for the purposes of comparison) it is only necessary to reckon it as three-fourths of the area of the square geographical mile; in other words, that four English square miles are equal to three geographical. This proportion may be deemed exact; for supposing a degree of latitude (between 51° and 52°) to measure 60,864 fathoms (on the authority of General Mudge) the area of an English square mile to the geographical square mile is as 300 to 398.6.

The English square mile contains 640 statute acres.

Scotland (with its islands) is about equal to Ireland in area, and is half as large as England and Wales; but in computing the area of Scotland in English square miles, it is right to mention that the Scottish mile is 5952 English feet, or (compared with the English mile) as 9 to 8:—But it is rapidly falling into disuse.

Col. 8.—The number of county magistrates who have qualified themselves to act, is considerably less than the total of this column, many of them acting for more than one county or jurisdiction.—Those who act for the Isle of Ely are included in Cambridgeshire; and the justices acting for the Ainstey of the city of York, are included in the East Riding. One hundred and eighty-three cities and towns have magistrates who lay claim to an *exclusive* jurisdiction; but most of them exercise only a *concurrent* jurisdiction with the county magistrates, and some of them no jurisdiction at all.

Col. 9.—Parishes not being always conterminous with the county in which the parish church is situate, it is necessary to remark, that 268 parishes in England and Wales are known to extend into two counties, two parishes into three counties each; (for particulars the abstract may be consulted) but the parish is herein

Population.

uniformly ascribed to the county in which the parish church is situate. The parish churches in England and Wales are no more than 10,458 in number, 139 parishes being annexed to others as far as concerns the offices of the church, and 96 parishes having no church whatever, or none fit for divine service.

Col. 10.—The number of places which separately and distinctly levy a rate to maintain their own poor is 14,640, according to the poor return abstract of 1815: the larger number of returns under the population act, arises from extra-parochial places, and returns of *constabularies* instead of townships, in some of the northern counties.

Col. 11.—This column includes the returns received from 889 chapelries.

Col. 12.—The *unentered* baptisms, burials, and marriages, mentioned in the parish register abstract at the end of the several counties, are included in these computations.

ENGLAND.

POPULATION.

COUNTIES of	1. 1700.	2. 1750.	3. 1801.	Increase per cent	4. 1811.	Increase per cent.	5. 1821.	6. Area in Square Miles (English.)	7. Divisional Meetings or Petty Sessions	8. Acting County Magistrates.	9. Number of Parishes	10. Number of Population Returns, 1821	11. Number of Parish Register Returns. 1821.	12. Annual Proportions.		
														One Baptism to	One Burial to	One Marriage to
ford	48,500	53,900	65,500	11	72,600	18	85,400	463	6	41	123	147	128	36	62	131
ks	74,700	92,700	112,800	8	122,300	10	134,700	756	9	93	151	230	160	34	58	145
kingham	80,500	90,700	111,000	10	121,600	13	136,800	740	10	136	202	240	206	35	56	144
nbridge	76,300	72,000	92,300	13	104,500	19	124,400	858	11	63	167	176	175	32	58	126
ster	107,000	131,600	198,100	18	234,600	17	275,500	1,052	6	69	90	501	128	36	55	136
nwail	105,800	135,000	194,500	15	223,900	17	262,600	1,327	16	99	203	218	205	34	71	151
nberland	62,300	86,900	121,100	14	138,300	15	159,300	1,478	5	55	104	302	137	34	58	154
rby	93,800	109,500	166,500	15	191,700	13	217,600	1,026	6	54	139	337	188	35	63	153
von	248,200	272,200	354,400	12	396,100	13	447,900	2,579	20	167	465	487	472	32	61	127
rset	90,000	96,400	119,100	8	128,900	14	147,400	1,005	9	63	271	309	267	36	66	154
rham	95,500	135,000	165,700	11	183,600	15	211,900	1,061	16	74	75	302	99	34	55	143
ex	159,200	167,800	234,000	11	260,900	13	295,300	1,532	14	188	406	431	403	35	59	150
ucester	155,200	207,800	259,100	14	295,100	16	342,600	1,256	18	179	339	439	341	37	64	119
reford	60,900	74,100	92,100	6	97,300	8	105,300	860	12	136	219	281	225	38	63	170
rtford	70,500	86,500	100,800	14	115,400	15	132,400	528	12	95	132	150	132	34	58	179
ntingdon	34,700	32,500	38,900	13	43,700	14	49,800	370	3	22	103	107	98	35	63	132
nt	153,800	190,000	317,800	21	385,600	13	434,600	1,537	14	168	411	446	402	31	60	130
ncaster	166,200	297,400	695,100	23	856,000	25	1,074,000	1,831	16	100	70	464	203	32	55	120
icester	80,000	95,000	134,400	15	155,100	15	178,100	804	6	52	216	348	259	36	59	135
ncoln	180,000	160,200	215,500	14	215,900	17	288,800	2,748	16	110	629	745	623	32	62	138
ddlesex	624,200	641,500	845,400	17	985,100	19	1,167,500	282	13	200	197	239	201	38	47	106
nmouth	39,700	40,600	47,100	36	64,200	13	72,300	498	10	39	125	158	127	47	70	154
rfolk	210,200	215,100	282,400	7	301,800	16	351,300	2,092	33	154	731	751	691	33	61	136
rthampton	119,500	123,300	136,100	7	146,100	13	165,800	1,017	9	79	306	346	296	36	58	134
rthumberland	118,000	141,700	162,300	10	177,900	14	203,000	1,871	7	43	88	534	100	38	38	145
ttingham	65,200	77,600	145,000	16	168,400	13	190,700	837	10	56	212	269	217	33	58	133
tford	79,000	92,400	113,200	9	123,200	13	139,800	752	13	59	217	307	236	35	61	153
tland	16,600	13,800	16,900	1	17,000	11	18,900	149	1	7	52	56	50	36	62	148
lop (Shropshire)	101,600	130,300	172,200	17	200,800	5	210,300	1,341	11	109	216	308	234	35	58	155
merset	195,900	224,500	282,800	11	313,300	16	362,500	1,642	16	130	475	517	479	37	63	149
uthampton (Hampsh.)	118,700	137,500	226,900	12	253,300	14	289,000	1,628	11	110	298	349	311	32	58	117
afford	117,200	160,000	247,100	23	304,000	14	347,900	1,148	8	62	145	350	180	32	56	128
ffolk	152,700	156,800	217,400	12	242,900	14	276,000	1,512	16	110	510	523	502	35	67	139
rrey	154,900	207,100	278,000	20	334,700	22	406,700	758	11	165	142	161	144	40	52	148
ssex	91,400	107,400	164,600	19	196,500	21	237,700	1,463	16	134	310	329	302	33	72	151
arwick	96,600	140,000	215,100	10	236,400	18	280,000	902	14	61	205	265	209	37	52	123
estmoreland	28,600	36,300	43,000	10	47,500	10	52,400	763	4	32	32	121	68	35	58	155
ilts	153,900	168,400	191,200	5	200,300	13	226,600	1,379	16	91	300	388	314	37	66	145
orcester	88,200	108,000	143,900	15	165,900	13	188,200	729	13	90	171	247	202	34	56	143
ork, East Riding	96,200	85,500	144,000	20	173,000	12	194,300	5,961	13	48	237	450	246	33	57	127
Do. North Riding	98,600	117,200	160,500	7	171,100	10	187,400		20	93	183	533	224	36	63	151
Do. West Riding	236,700	361,500	582,700	16	675,100	21	815,400		19	110	193	668	298	35	61	131
ENGLAND	5,108,500	6,017,700	8,609,000	14¾	9,870,300	16⅞	11,486,700	50,535	511	3,968	9,860	14,532	10,487	35	57	133
WALES	366,500	449,300	559,000	13	632,200	15¾	731,800	7,425	84	462	833	1,241	855	41	69	156
Totals	5,475,000	6,467,000	9,168,000	14⅗	10,502,500	16½	12,218,500	57,960	595	4,430	10,693	15,773	11,342	35	58	134

WALES.

COUNTIES OF	POPULATION. 1. 1700.	2. 1750.	3. 1801.	Increase per cent.	4. 1811.	Increase per cent.	5. 1821.	6. Area in Square Miles (English.)	7. Divisional Meetings, or Petty Sessions.	8. Acting County Magistrates.	9. Number of Parishes.	10. Number of Population Returns, 1821.	11. Number of Parish Register Returns, 1821.	12. Annual Proportions. One Baptism to	One Burial to	One Marriage to
Anglesey	22,800	26,900	35,000	10	38,300	20	46,000	271	4	22	67	76	72	41	83	146
Brecon	27,200	29,400	32,700	19	39,000	14	44,500	754	6	43	66	120	72	53	67	158
Cardigan	25,300	32,000	44,100	18	52,000	13	59,000	675	9	46	65	109	70	40	70	159
Carmarthen	49,700	62,000	69,600	15	79,800	15	92,000	974	8	35	77	124	81	45	67	142
Carnarvon	24,800	36,200	43,000	19	51,000	16	59,100	544	5	31	69	77	69	38	69	149
Denbigh	39,700	46,900	62,400	6	66,400	18	78,000	633	8	36	59	108	59	37	62	154
Flint	19,500	29,700	41,000	17	48,100	14	54,900	244	7	24	27	68	31	34	64	190
Glamorgan	49,700	55,200	74,000	19	88,000	18	103,800	792	9	77	125	189	123	43	69	158
Merioneth	23,800	30,900	30,500	5	32,000	9	35,100	663	6	23	34	45	34	43	67	163
Montgomery	27,400	37,000	49,300	9	53,700	14	61,100	839	9	37	51	92	53	38	65	160
Pembroke	41,300	44,800	58,200	8	62,700	20	75,500	610	7	67	141	158	139	47	83	150
Radnor	15,300	19,200	19,700	10	21,600	8	23,500	426	6	21	52	75	52	36	64	159
Totals	366,500	449,300	559,000	13	632,600	16	731,800	7,425	84	462	833	1,241	855	41	69	156

SCOTLAND.

SHIRES OF	POPULATION. 1801.	Increase per cent.	1811.	Increase per cent.	1821.	Number of Parishes.	Number of Population Returns, 1821.
Aberdeen	127,200	10	139,600	14	158,500	82	93
Argyll	74,300	19	88,400	12	99,300	50	56
Ayr	87,100	23	107,400	21	129,800	46	51
Banff	37,000	2	37,900	17	44,400	23	27
Berwick	31,600	1	31,800	7	34,100	33	34
Bute	12,200	2	12,400	13	14,100	5	6
Caithness	23,400	4	24,200	27	30,800	10	10
Clackmannan	11,200	11	12,400	9	13,500	5	6
Dumbarton	21,400	17	25,000	11	27,900	12	12
Dumfries	56,400	15	65,100	11	72,300	43	45
Edinburgh	127,100	21	153,600	27	195,300	41	46
Elgin	27,600	5	29,000	9	31,800	20	23
Fife	96,900	8	104,600	12	116,800	61	76
Forfar	102,400	8	110,800	4	115,700	54	56
Haddington	31,000	4	32,200	11	35,800	24	25
Inverness	76,800	5	80,900	14	92,000	30	37
Kincardine	27,200	4	28,400	5	29,700	19	21
Kinross	6,900	8	7,500	6	7,900	4	7
Kirkcudbright	30,200	15	34,800	14	39,700	28	28
Lanark	151,600	31	198,100	26	249,300	50	51
Linlithgow	18,400	9	20,100	15	23,100	13	15
Nairn	8,500	—	8,500	8	9,200	4	7
Orkney and Shetland	48,400	—	47,700	14	54,200	53	56
Peebles	9,000	14	10,300	—	10,200	16	16
Perth	130,600	7	139,600	2	141,800	81	83
Renfrew	80,700	19	96,100	19	114,400	17	22
Ross and Cromarty	57,200	10	62,900	12	70,200	33	33
Roxburgh	34,800	11	38,500	8	41,700	32	34
Selkirk	5,200	16	6,100	11	6,800	5	9
Stirling	52,500	15	60,200	11	66,700	24	29
Sutherland	23,900	2	24,400	—	24,300	13	15
Wigtown	23,700	17	27,800	22	33,900	17	17
Totals	1,652,400	13	1,865,900	14⅓	2,135,300	948	1,046

Population of the Towns of Great Britain above 15,000

ENGLAND.

	Population in 1821.
London,	1,225,694
Manchester,	133,788
Liverpool,	118,972
Birmingham,	106,722
Bristol,	87,779
Leeds,	83,796
Plymouth,	61,212
Portsmouth, portion of Gosport,	45,648
Norwich,	50,288
Sheffield,	42,157
Deptford and Greenwich,	40,574
Nottingham,	40,415
Bath,	36,811
Newcastle-upon-Tyne,	35,181
Kingston-upon-Hull,	31,425
Leicester,	30,125
Brighton,	24,429
Chatham and Rochester,	24,063
Exeter,	23,479
Shrewsbury,	21,694
Coventry,	21,242
York,	20,787
Chester,	19,949
Yarmouth,	18,040
Macclesfield,	17,746
Wigan,	17,716
Derby,	17,423
Wenlock,	17,265
Ipswich,	17,186
Worcester,	17,023
Woolwich,	17,008
Oxford,	16,365
Carlisle,	15,476

SCOTLAND.

Glasgow,	147,043
Edinburgh and Leith,	138,235
Dundee,	30,575
Paisley,	28,000
Aberdeen,	26,485
Greenock,	22,088
Perth,	19,068

IRELAND.

Dublin, estimated in 1812 at about	278,000
Limerick, estimated according to Wakefield,	60,000
Cork, * 4 years preceding 1811,	55,265
Waterford,	35,000
Belfast, estimated in 1812,	30,000
Londonderry,	18,500
Kilkenny,	15,000

In a very interesting paper on the "Numerical Changes of the Population of Great Britain, as divided into the classes of Agriculturists, Manufacturers, and non-productive Labourers, during the period from 1811 to 1821," by Mr. George Harvey, F.R.S.E.† that able writer has given the following results. The sign + indicates in the column of agriculture, for example, that the agricultural population has increased by the number annexed to it in every particular county of any of the three kingdoms; and the sign — that the same population has diminished.

The total population of each county has been assumed at 10,000 families, the returns having been given only in families in relation to these subjects.

Proportional change of 10,000 Families chiefly employed

In Agriculture.		In Trade, Manufactures, or Handicraft.		Otherwise than the two preceding Classes.	
GENERAL RESULTS.					
England,	—168	England,	+175	England,	— 7
Wales,	—555	Wales,	+ 63	Wales,	+492
Scotland,	—211	Scotland,	+ 83	Scotland,	+178
ENGLAND.					
Rutland,	+432	Stafford,	+732	Durham,	+518
Northampton,	+400	Derby,	+609	Worcester,	+404
Buckingham,	+235	Westmoreland,	+591	York, North Riding,	+343
Salop,	+192	Sussex,	+563	Norfolk,	+283
Huntingdon,	+102	Cornwall,	+557	Hertford,	+252
Oxford,	+ 79	York, East Riding,	+539	Devon,	+233
Lincoln,	+ 69	Monmouth,	+517	Northampton,	+231
Kent,	+ 65	Warwick,	+450	Buckingham,	+227
Suffolk,	+ 50	Surrey,	+425	Cumberland,	+175
Dorset,	+ 49	Lancaster,	+421	Chester,	+169
Essex,	+ 47	Northumberland,	+384	Somerset,	+169
Southampton,	— 9	Huntingdon,	+322	Wilts,	+168
Berks,	— 21	York, West Riding,	+265	Bedford,	+133
Westmoreland,	— 22	Cambridge,	+197	Southampton,	+130
Surrey,	— 28	Gloucester,	+146	Nottingham,	+120
Cambridge,	— 36	Berks,	+140	York, West Riding,	+ 87
Middlesex,	— 50	Essex,	+132	Kent,	+ 72
Devon,	— 78	Lincoln,	+107	Leicester,	+ 72
Hereford,	— 88	Leicester,	+106	Hereford,	+ 30
Somerset,	— 89	Cumberland,	+101	Gloucester,	— 10
Hertford,	—122	Middlesex,	+ 63	Middlesex,	— 13
Norfolk,	—125	Hereford,	+ 58	Suffolk,	— 26
Nottingham,	—128	Oxford,	+ 50	Dorset,	— 34

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* Wakefield supposes that the population of Cork may amount to 80,000.

† See the *Quarterly Journal*, No. XXXII. p. 203.

Population.

As the increase of the population of the States of North America, is a subject of great interest, we shall lay before our readers several tables, computed by Mr. Harvey (see *Edinb. Phil. Jour.* vol. viii. and ix.) which contain much curious information on this point. According to Dr. Franklin and Dr. Pitkin, the following was the ratio of increase of the whole American population.

1731 to 1747	4.6 Per Cent.
1749 to 1790	275.5
1790 to 1800	35.1
1800 to 1810	36.1
1810 to 1820	32.9

As the last three results are the only ones that can be relied on, the periods to which they belong have been alone adopted in the following table, showing the increase which the different States have received since 1790.

	STATES AND TERRITORIES.	Increase per cent. from 1790 to 1800.	Increase per cent. from 1800 to 1810.	Increase per cent. from 1810 to 1820.
North. States.	Maine,	57.2	50.7	30.4
	New Hampshire,	29.6	16.6	13.9
	Massachusetts,	11.6	11.6	10.9
	Rhode Island,	0.4	11.3	7.9
	Connecticut,	5.5	4.4	5.1
	Vermont,	80.6	41.1	8.2
Middle States.	New York,	72.3	63.6	32.7
	New Jersey,	14.7	16.3	13.0
	Pennsylvania,	38.7	34.4	29.5
	Delaware,	8.8	13.1	0.1
	Ohio,	27.1	408.7	151.9
	Indiana,	——	334.7	500.2
Southern States.	Maryland,	10.7	7.5	7.0
	Virginia,	17.7	10.7	9.3
	North Carolina,	21.4	16.2	15.0
	South Carolina,	38.7	20.1	18.1
	Georgia,	97.1	55.2	35.1
	Louisiana,	——	——	635.9
	Tennessee,	——	14.8	61.6
	Kentucky,	199.9	83.9	38.8
Territorial Gover.	Alabama,	——	——	67.1
	Mississippi,	——	35.6	87.0
	Illinois,	——	——	349.5
	Missouri,	——	——	——
	Michigan,	——	——	86.8
	Arkansas,	——	——	——
	Columbia,	——	303.8	37.5

The following table shows the various rates of increase in the different ages of males and females, as deduced from the returns of 1810 and 1820.

	STATES AND TERRITORIES.	MALES.					FEMALES.				
		Under 10.	10 and under 16.	16 and under 26.	26 and under 45.	45 and upwards.	Under 10.	10 and under 16.	16 and under 26.	26 and under 45.	45 and upwards.
North. States.	Maine,	19.2	14.7	39.8	25.6	44.3	18.9	34.5	44.8	31.6	48.0
	New Hampshire,	3.4	10.3	20.4	11.8	27.3	7.1	9.5	19.3	17.6	31.1
	Massachusetts,	2.9	10.3	9.9	18.7	10.6	3.6	15.7	13.9	17.2	15.7
	Rhode Island,	7.4	5.5	4.8	12.6	8.3	3.4	7.1	11.8	13.6	12.3
	Connecticut,	2.6	0.9	8.2	8.2	6.5	1.8	4.8	8.9	10.6	10.1
	Vermont,	6.6	4.9	22.7	6.0	24.0	3.7	7.1	17.8	13.9	32.9
Middle States.	New York,	34.2	41.4	54.8	46.1	50.5	37.1	48.1	55.6	51.4	54.9
	New Jersey,	11.2	5.6	16.1	14.1	15.8	10.7	9.7	20.9	15.6	19.4
	Pennsylvania,	26.6	23.1	38.2	30.9	23.8	26.5	28.7	33.5	33.2	30.3
	Delaware,	6.2	0.1	7.1	4.6	13.4	4.4	1.4	0.6	0.2	14.7
	Ohio,	139.5	153.1	182.4	139.5	164.3	139.9	161.5	166.8	151.1	171.8
	Indiana,	501.8	495.9	531.7	507.6	528.1	507.7	474.7	511.9	538.8	539.0
Southern States.	Maryland,	7.5	2.5	16.4	10.6	11.8	9.2	9.8	14.3	15.0	11.7
	Virginia,	6.3	6.6	14.4	10.1	8.3	8.6	8.4	13.7	9.4	9.8
	North Carolina,	10.9	8.5	14.1	5.2	20.1	8.5	10.1	11.4	12.2	23.0
	South Carolina,	5.1	3.7	11.6	5.3	20.2	3.9	10.1	12.5	7.6	18.
	Georgia,	26.6	23 4	38.3	24.4	46.1	26.2	32.9	38.5	23.9	44.9
	Louisiana,	243.7	250.2	457.8	443.1	398.7	244.3	333.5	368.8	315.9	451.9
	Tennessee,	52.3	65.9	59.2	37.0	76.2	51.7	70.1	58.9	56.8	84.3
	Kentucky,	27.5	34.3	38.8	29.2	43.3	27.7	36.4	42.0	36.9	54.3
Territories.	Alabama,	192.5	152.1	215 1	76.4	62.0	193.6	143.0	178.1	118.9	93.1
	Mississippi,	92.2	96.5	69.4	61.7	100.7	79.8	105.7	73.3	77.2	136.4
	Illinois,	365.8	37.3	388,6	329.8	375.0	373.4	408.0	359.8	366.0	395.3
	Michigan,	52.5	65.0	128.8	117.7	79.1	76.5	58.1	88.0	91.3	104.6
	Columbia,	32.2	32.1	42.8	37.3	49.1	30.8	37.6	52.3	50.8	62.4

The following Tables, also computed by Mr. Harvey, show the state of the slave population in the United States.

Taking the total amount of each class of the free white population in all the provinces in 1820, we obtain the following results, which Mr. Harvey considers as proving the baneful effects of hard labour and coercion on the slaves.

Class of persons.	Under 20.	Of 26 and under 45.	Of 45 and upwards.
Males, Free,	354	100	65
Males, Slaves,	334	100	47
Females, Free,	362	100	63
Females, Slaves,	346	100	46

The following Table shows the rate of increase and decrease in the slave population.

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	STATES AND TERRITORIES.	Rates of Increase or Decrease, from 1790 to 1800.	Rates of Increase or Decrease, from 1800 to 1810.	Rates of Increase or Decrease, from 1810 to 1820.
North. States.	Maine,			
	N. Hampshire,	— 94.9		
	Massachusetts,			
	Rhode Island,	— 60.0	— 71.6	— 58.3
	Connecticut,	— 65.6	— 67.4	— 68.7
	Vermont,			
Middle States.	New York,	— 3.4	— 37.3	— 32.8
	New Jersey,	+ 8.7	— 14.5	— 30.4
	Pennsylvania,	— 54.3	— 114.6	— 73.5
	Delaware,	— 44.4	— 47.3	+ 7.9
	Ohio,			
	Indiana,			— 19.8
Southern States.	Maryland,	+ 5.4	+ 2.7	— 3.8
	Virginia,	+ 18.2	+ 13.5	+ 8.3
	N. Carolina,	+ 32.5	+ 26.7	+ 21.5
	S. Carolina,	+ 36.5	+ 34.4	+ 28.2
	Georgia,	+ 198.2	+ 76.2	+ 42.2
	Louisiana,			+ 2193.7
	Tennessee,		227.8	+ 79.9
	Kentucky,	+ 224.6	+ 99.7	+ 57.3

	STATES AND TERRITORIES.	Rates of Increase or Decrease from 1790 to 1800.	Rates of Increase or Decrease from 1800 to 1810.	Rates of Increase or Decrease from 1810 to 1820.
Territories.	Alabama,			+ 20.8
	Mississippi,		+ 389.8	+ 92.0
	Illinois,			+ 44 5.8
	Missouri,			
	Michigan,			
	Arkansas,			
	Columbia,		+ 360.3	+ 18.2
The entire slave population		+ 28.2	+ 33.2	+ 29.1

Population || Porcelain.

The following Table shows the relation of the slave to the free population, and the increments of the slaves and free persons in different years and different states.

Date	KENTUCKY.			MISSISSIPPI.			NORTH CAROLINA.			ENTIRE POPULATION.		
	Relation of Slaves to Free Persons.	Increments to Free Persons.	Increments to Slaves.	Relation of Slaves to Free Persons.	Increments to Free Persons.	Increments to Slaves.	Relation of Slaves to Free Persons.	Increments to Free Persons.	Increments to Slaves.	Relation of Slaves to Free Persons.	Increments to Free Persons.	Increments to Slaves.
1790	One Slave to 5.0			One Slave to *			One Slave to 2.9			One Slave to 4.6		
1800	4.5	199.9	224.6	1.5	*	*	2.6	21.4	32.5	4.9	35.1	28.2
1810	4.0	83.9	99.7	1.4	35.6	389.8	2.3	16.2	26.7	5.1	36.1	83.2
1820	3.5	38.8	57.3	1.5	87.0	92.0	2.1	15.0	21.5	4.3	32.9	29.1

POPULATION OF HINDOSTAN.

The following is an approximate estimate of the population of the principal cities of Hindostan.

Benares, .	600,000	Ahmedabad, .	100,000
Calcutta, .	500,000	Cashmere, .	100,000
Surat, .	450,000	Furruckabad,	70,000
Madras, .	300,000	Mirzapore, .	69,000
Lucknow, .	200,000	Agra, .	60,000
Hydrabad, .	200,000	Bareilly, .	60,000
Dacca, .	180,000	Burdwan, .	54,000
Bombay, .	176,000	Bangalore, .	50,000
Delhi, .	150,000	Chupra, .	48,000
Moorshedabad,	150,000	Seringapatam,	40,000
Pound, .	120,000	Broach, .	33,000
Nagpoor, .	100,000	Mangalore, .	30,000
Baroda, .	100,000	Palhampour, .	30,000

The total population of Hindostan is estimated at 134,000,000, and 1,280,000 square miles.

K. PORCELAIN is a species of the finest earthenware, denominating dishes or vessels of any size or form, semi-pellucid, and of a character partaking of the nature of earth and of glass. Porcelain is also designated china-ware, because that manufacture was first invented in China, and has attained there, notwithstanding the various attempts made in Europe, to a degree of perfection hitherto almost unrivalled. In China this manufacture is named *tse-ki*, a word peculiar to that country; and the term porcelain, now in common use except in the east, is evidently of European derivation, as the Chinese language recognises no such sounds. Of the origin and meaning of this modern term, various conflicting conjectures have been made. Nor can the question now be settled. But the most common and the most satisfactory opinion seems to be, either that it is derived from the Portuguese *porcelana*, a cup, because the Portuguese were the first to introduce this manufacture into Europe, or is compounded of the French words *pour cent années*, because it was erroneously supposed that the materials of which porcelain is composed required to be matured under ground for a hundred years.

Origin and history.

The manufacture of porcelain, as hinted above, was invented and carried on in China many centuries, it is ascertained, ere that country was known to Europeans. It is mentioned in the Chinese annals as an important and extensive manufacture so early as the year 442. The invention of this art, however, must have taken place long prior to this date, as porcelain was then made of the same materials as at present, and as it had then also arrived at a degree of perfection which no subsequent skill or experience has been able to surpass. On the contrary, it is universally believed in China, that the porcelain-ware of former times was much superior to any of which the present age can boast. This manufacture has been attempted in various parts of China, in Quan-tong and Fo-kien; but it has attained to its greatest eminence in King-te-tching, a town, or, to use the language of the country, a village in the province of Kiangsi, the place from which the European trade is chiefly supplied, and which has thus the distinction of furnishing the greater part of the world with this elegant and delicate commodity. This

Introduction into Europe.

art was known, also, at a very remote date in Japan, and a few other places in the east, in none of which, however, has it rivalled the production of the mighty empire where it was invented. The Portuguese [*] are generally allowed to have been the first that introduced the knowledge of it into Europe; but at what date has not been ascertained, though, after it was introduced, many ages elapsed ere any attempts were made to carry it into practice. It is not, indeed, much more than a century since porcelain was really manufactured in this quarter of the globe. M. de Botticher, a German chemist, had the honour of being the first in Europa that understood the nature of porcelain manufacture, or rather who invented it. This philosopher having been thrown into prison on suspicion of being master of the philosopher's stone, continued his experiments, though in confinement, with inflexible ardour, and thus fabricated, though accidentally, the first porcelain really made in the western world. In making some crucibles, he found that heat imparted to them the appearance of porcelain, which, imported from China, was common throughout Europe; and this accidental discovery laid the foundation of that celebrated manufactory at Meissen, near Dresden, which has produced porcelain of the most beautiful and perfect kind, the best certainly in Europe, and reckoned by some not much inferior to any manufactured in China. Botticher, however, (who died in 1719,) understood the art of making white porcelain only, the endless variety of colour of which this ware is susceptible not having been known for some years after his death. He was succeeded by several eminent philosophers and manufacturers, particularly M. Reaumur, who improved upon his discoveries, and contributed to bring the art to very considerable perfection in Europe, and almost to rival, in some respects, the ancient and celebrated manufactures of the east. The first European porcelains were made in Saxony. France soon followed the example; and manufactories of this article were ere long established in England, and in all the principal countries in Europe, each of these places possessing some characteristics peculiar to itself, and all differing more or less from the porcelain of China or Japan, yet not reckoned inferior to them in any hopeless degree, either in beauty, lustre, or value.

Of what substances formed.

In China, the principal materials of which porcelain is formed are two kinds of stone or earth, denominated kaolin and petuntse, with two kinds of oil or varnish, one of which is extracted from the hard stone of which the petuntses are formed, while the other is the oil of lime, obtained, as shall soon be shown, by a considerably tedious preparation.

Kaolin and petuntse.

Of the nature of kaolin and petuntse, there have been many various conjectures. This question, however, may be said now to be about decided. These substances have been analysed by Reaumur, Scheffer, and others, whose opinions and inferences have very nearly coincided. The analysis of Vauquelin, which has obtained the authority of the late Dr. John Murray of Edinburgh, and which is not essentially different from that of his predecessors, may be regarded as perfectly satisfactory and unexceptionable. The result of the analysis is as follows; the kaolin consists of silex 74, alumina 16.5, lime 2, and water 7.; the petuntse of silex 74, alumina 14.5, lime 5.5. The two principal ingredients, therefore, of which porcelain is made, are of a siliceous and argillaceous character, in which the former predominates. Though siliceous earth is the ingredient in largest proportion in these compounds, yet it is the argillaceous substance which gives them their character, as it communicates ductility to the mixture when soft, and renders it capable of being turned to any shape on the lathe, and of being baked, a process afterwards to be described. The perfection of porcelain consists in the purity of these ingredients; and hence, in Europe, the purest natural clays, or those which consist of silicia and alumina alone, are always preferred. From the above analysis, it is evident that there is rather less than five per cent of lime in the two substances in question. Lime in that proportion does not injure, or rather it improves the character of the porcelain; but, in greater proportions, it renders the mixtures too fusible; in which case the purity of the other ingredients, and the greatest care or ingenuity on the part of the workmen, can be of no avail. Petuntse and kaolin are found in quarries of great depth, and of inexhaustible extent, about twenty or thirty miles from King-te-tching, and in other parts of the east. Identical substances are not to be found in any part of the western world, though analogous ones are sufficiently abundant. "It is difficult," to quote the words of a celebrated chemist, "to procure in Europe natural clays equally pure; and hence, in part, the difficulty of imitating the porcelain of the east. Such clays, however, have now been discovered in different countries, and the European porcelain has attained considerable perfection. The fine Dresden porcelain, that of Berlin, the French porcelain, and the finer kinds which are formed in this country, are manufactured of the clay which has received the name of porcelain earth, and which appears in general to be derived from the decomposition of the feldspar of granite," of the nature of which, it may be remarked, petuntse and kaolin, according to M. Bomare and others, partake in an eminent degree. "The clay of Cornwall, from which the finer kinds of English porcelain are made, has this origin. Earthy mixtures, containing magnesia, are also used in the manufacture. Giobert analysed an earth which had long been employed for this purpose and considered as a clay of great purity, and found that it consisted almost entirely of carbonate of magnesia and silex. The proportion of the earths to each other is likewise of importance; and from differences in this respect arises the necessity frequently of employing mixtures of clays. The proportion of silex in porcelain of a good quality is, according to Vauquelin, at least two-thirds of the composition; and of alumina from a fifth to a third; magnesia is of utility by lessening the tendency which the composition of the other earths alone has to contract in baking. From what we know of the fusibility of mixtures of these earths, too large a proportion of magnesia will render the composition too fusible."

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[*] If conjecture, which is supported by no less a man than Scaliger, may be relied on, this art was known to the Romans, and could not therefore have been introduced into Europe from China, as no communication was opened with the east till many centuries after the fall of the Roman empire. The terms *vasa*, *murrhina*, *murrina*, *murrea*, have been regarded by that famous scholar as synonymous with our modern name porcelain. Others, with more probability, have supposed that the vessels to which these terms are applied, and which are described by Pliny, were made of a species of precious stones, found in Parthia, of a colour and appearance not unlike the manufacture which forms the subject of this article. The Romans, at least, it is well known, understood the manufacture of pottery, which is a kindred art, at an extremely distant period.—(Plinii *Hist. Natur.* xxxvii. 2.)

ain.

In addition to kaolin and petuntse, the Chinese, as mentioned above, use also two oils or varnishes in the manufacture of porcelain. Of these oils one is extracted from the stone of which the petuntses are formed, the kind which is the whitest, and whose spots are the greenest, being chosen for this purpose. To a hundred pounds of this oil they put a mineral stone called shekau or kekao, resembling an alum, and which, when reduced to an impalpable powder, serves to give the oil a consistence, though it must always be kept in a liquid state. The other oil is the oil of lime, the preparation of which, as stated above, is extremely tedious. Having dissolved and reduced to powder large pieces of quicklime, they sprinkle water on it. On this powder they lay alternately couches of dry fern and slaked lime, till they have erected a considerably large pile. They then set fire to it; and, with the ashes that remain, and with dry fern alternately, as before, they repeat the same process five or six times successively; and the oil, thus prepared, is regarded as an important ingredient (though considerable skill is required to prevent too much of it being used) in the manufacture of porcelain, as imparting to it all its lustre and transparency.—It may not be improper to mention, that the term oil is used by the Chinese in a very peculiar and vague sense. It seems with them to signify generally any thing in a state of liquidity; and they call their varnishes oils, though made of the powders of earths and stones, mixed with water.

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There is still another ingredient made use of in the manufacture of porcelain, namely, hoache, a substance of a chalky or siliceous nature. This may be used either instead of kaolin, by undergoing a similar process of preparation, or as a varnish, the vessel when made being plunged into it, by which means it derives the greatest splendour and whiteness. The porcelain made of hoache is extremely light and brittle, and considerably more expensive than that formed of kaolin.

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In preparing the petuntse and kaolin, the first object is to break and pound them in a mortar till they are reduced to almost impalpable powder. In this state a quantity of water is applied, and after they have been completely amalgamated, by being stirred with an iron instrument, they skim off from the surface a white substance, of three or four inches in depth, which they put into another vessel of water. This process is repeated till nothing is left but the coarse residuum of the powder, which is carefully preserved; and, after being pounded again, is used as a new powder.

With regard to the second vessel, in which the skimmings of the first were put, the water being soon separated from the ingredients with which it had been blended, is poured out; and the sediment which remains at the bottom of the vessel is then put into a mould of a square shape, and after being dried, requires only to be mixed with the proper materials for being fashioned into porcelain. The two substances, petuntse and kaolin, undergo a similar preparation; though the latter, being naturally soft and more dissoluble, requires not to be broken, but merely to be immersed in water.

The just admixture of the different ingredients is the next step in the process of the porcelain manufacture, and this must be determined by the quality of the porcelain to be made. For the finest porcelains they use an equal quantity of petuntse and kaolin; and the proportion of petuntse to increase as six to four, three to one, according to the degree of coarseness which the porcelain is meant to assume, the vessel being coarse in proportion as the quantity of petuntse exceeds that of kaolin in the manufacture of it. The two ingredients are, when thus combined, put into a large pit, or basin, well paved and cemented, and are trodden by the workmen, and hardened, till they obtain a proper degree of consistence. They are then removed from the basin, and rolled and kneaded a second time on a slate: a process which requires the greatest care and niceness, as the smallest vacuum, or the least admixture of any thing extraneous, even a hair or a grain of sand, would render the operation a complete and total failure, and the materials thus adulterated of no use at any future period. The oils, or varnishes, are next to be applied; the oil of lime being generally in the ratio of one to ten of the other oil, which, as previously described, is extracted from the stone from which petuntse is obtained. The proportion which these oils must bear to the other ingredients, depends entirely on the quality of the work to which they are applied. The mode of applying these oils will be mentioned in a subsequent part of this article.

How the porcelain is made.

Of the materials amalgamated and prepared in this way the porcelain is made. This is done either with the wheel, like our earthen-ware, or in moulds. All smooth dishes are made in the former way; and the largest are finished on the wheel by two operations, one-half being applied at a time. When the two halves have, in this way, been made to acquire the same size and figure, they are united with porcelain earth made liquid by adding water to it; and the juncture, which is polished by a kind of iron patula, is so perfect that it is not only entirely imperceptible, but is the strongest part of the vessel. It is in this way that handles, spouts, often embossed work, are added. Those vessels, on the contrary, that are embellished with figures in relievo, are formed, not on the wheel, but in moulds, and are polished and finished with the chisel. Others that have impressions in creux are engraven with a species of puncheon. Vessels with figures in relievo or in creux, belong, it is evident, in one respect at least, more to the profession of sculpture than to that of porcelain-making. This operation is, of consequence, assigned to a particular class of workmen; and as their labour is exclusively confined to this species of employment, it is performed with a degree of delicacy, rapidity, and elegance, which, considering the extreme brittleness of the article, is altogether astonishing. Nor is this the only department assigned to a separate class of workmen. On the contrary, the division of labour is carried to a very great extent in the porcelain manufactory. Every separate operation, however minute, is done respectively by different persons; and a single cup runs with expedition from one to another, till, before it is finished, it has passed through the hands of no fewer than seventy individuals.

Blue porcelain.

The Chinese, for many ages, used only white porcelain, which were first superseded by blue, and soon afterwards every variety and shade of colour was introduced. The blue, it is supposed, they originally prepared from a species of lapis lazuli, which, previous to being used, was calcined, and reduced to a powder of the greatest fineness. But as Britain can supply them with the smalt at a cheaper rate than they can prepare it, they obtain the article from this country. The fine deep blue, by which the most ancient china-ware was characterised, and which is so much valued by the curious, is now no longer to be seen. The art of making it, indeed, seems to be entirely lost; though it is supposed to have been obtained from the oxyd of cobalt, (with other minor preparations;) a mineral which may be found in various parts of China and of the East. Nor is this the only art in the department of painting which, though once fully understood, the Chinese have now altogether forgotten; and while it may be affirmed, with much truth, that while the manufacture of porcelain in China has not improved in the smallest degree these last five centuries, it has, in some respects, entirely deteriorated. In addition to the loss of the knowledge of producing the fine deep blue, as just mentioned, the art of making the magic porcelains has also entirely disappeared. These magic porcelains exhibit their colour and their devices only when filled with water, and were thus regarded as the most curious and romantic specimens of the art to which they belonged. Though the mode in which they were manufactured cannot now be described with accuracy, the following has been conjectured as not very remote from the truth. The first requisite, which was quite indispensable, was that the vessel be extremely thin, so that the figures to be formed might be sufficiently clear and perceptible. After the vessel had been baked, (a process soon to be described,) the figures, which were mostly fish, as these corresponded best with the water, must be formed on the inside; and after the colour has had time to dry, a second extremely thin coat, of the same substance of which the vessel was constructed, must be inserted on the inside, and varnished. The fish, or whatever is the device, will now, it is evident, be buried between the two coats of the ware of which the vessel is made. All that now remains to be done, is to grind the outside of the vessel as close to the figures as possible—to varnish it again—to subject it a second time to the furnace; and though, after the operation, the figures and embellishments will not be at all perceptible, yet, so soon as the vessel is filled with water, they will all at once be rendered clear and distinct to a degree scarcely credible. This beautiful art it has been attempted of late years to revive; but as the pains and delicacy required are so extremely great, and as the Chinese seem not now to be characterised by the same ingenuity or dexterity as in former ages, these attempts have hitherto been wonderfully unsuccessful.

Magic porcelains.

Painting.

It may here be mentioned with propriety that, though the painting of porcelain is distributed among a great variety of workmen, each having his own department, this art has not attained to any eminence or perfection in the east. With the exception of flowers and landscapes, which, though never remarkably elegant, are yet pretty correct and beautiful, the other species of painting are total failures, deficient both in design and execution, and such as would bring disgrace on the merest tyro in the art in this quarter of the world. If the Chinese, however, do not excel in painting, the colours which they use are prepared with a degree of niceness and skill, of which there is yet no instance in Europe, and are indeed so lively and brilliant, as to challenge all rivalry.

How the colours are obtained.

The different colours by which the Chinese porcelain is distinguished, are made from the oxyds of different metals, with other slight ingredients prepared and amalgamated in a way which, as just remarked, we cannot successfully imitate or understand. On this curious subject, almost the only information we possess is derived from Clouet and Brongniart. (Vide *Philosophical Magazine*, vol. vii. p. 1. and Nicholson's *Journal*, vol. iii. p. 101.) The following brief sketch will, we fear, afford the reader but a faint idea of the important art in question. Carmine red is obtained from the purple precipitate of the solution of gold by muriate of tin. This beautiful colour, however, is now comparatively little used, as it is apt to change from the great heat necessary to bake the vessel after it is applied. Violet results from the application of the same substances with a larger quantity of oxyd of lead. Rose red is produced by the oxyd of iron, highly oxydized by the action of nitric acid. For this purpose, the purest iron is dissolved in strong nitric acid; and the solution thus obtained must be allowed to stand till it is perfectly clear. Then add a solution of the carbonate of potash, till the whole of the oxyd of iron is precipitated. This precipitate must now be washed carefully with hot water, and the last washing drawn off by heat, raised almost to redness,—which will expel the carbonic acid. The oxyd, after this operation, will have assumed a fine red colour, and be fit for application. The white oxyd of antimony, with oxyd of lead and silex, is employed to give a yellow colour. Blue, as formerly hinted, is produced from oxyd of cobalt; green from oxyd of copper; brown from various proportions of manganese, copper, and iron mixed. The colours thus obtained are applied to the surface of porcelain by means of fluxes or enamels, more fusible than the matter of the porcelain. "The flux generally employed to fix the colouring matter," says a celebrated chemist, "is either a mixture of vitrified oxyd of lead and silex or borax, or sometimes a mixture of all these. By promoting the fusion of the metallic oxyd, it causes it to adhere at a lower heat than that by which it might be decomposed, and the colour changed; it also serves as a medium of union with the matter of the porcelain, and renders the surface more smooth. The method of applying it is either to mix the metallic oxyd, or mixture of oxyds, which is to give the colour, with the materials of the flux, the whole being reduced to an impalpable powder, which is made into a thick liquid, with gum water or with a volatile oil, and applied by a pencil to the surface of the unglazed porcelain; or the colouring matter and the matter of the flux are fused together, and the enamel thus formed being reduced to a fine powder, is applied in a similar manner. The first mode is generally employed with those colours which are liable to be altered by heat." The common kinds of porcelain, it may be remarked, are painted by means of copperplate prints, which, however, are more used in common earthen-ware than in porcelain.

Stamp

But painted figures and embellishments are not the only ornaments by which the porcelain of the Chinese is distinguished. That celebrated and ingenious people *stamp* or imprint a great variety of figures on the surface of vessels of white porcelain, though the surface be quite smooth and the vessels extremely thin. The mode in which this operation is performed is the following: A vase of the finest materials, and as thin as possible, is constructed; and when it has been polished on the wheel, both inside and out, they insert into it a stamp of nearly its own shape and dimensions, but cut with such figures as they wish the newly formed vase to assume. They next press down this stamp so firmly, that the moist vessel receives, in the most perfect way, the impression thus communicated; and if in consequence of this pressure, the shape of the new vessel be injured, they have merely to apply it to the wheel again to restore it. After having polished and finished it as nearly as possible, the only other step is to cover it within and without with the finest white varnish; and this varnish, while it occupies all the cavities which the stamp had made, and renders the surface perfectly smooth, gives at the same time a darkish hue and aspect to the figures in proportion to the quantity of it required in filling them up; so that the whole device is as clearly seen and as exquisitely shaded as if the figures had been carefully painted on the outside. This method of stamping porcelain, though simple, has not yet been tried in Europe; nor has the following department of this art, though equally simple, been carried on any where but in the east.

rbled celain. The kind to which we allude is the marbled porcelain, called by the Chinese *tsou-tchi*. The vase after being formed, baked, and polished, is covered over, not with the common varnish, but with a sort of coarse agates, calcined to a white powder, and separated from the grosser parts by means of water. The powder, reduced by water to about the consistence of cream, is the varnish used in this operation. And the great peculiarity of this kind of porcelain is, that this varnish does not spread over the vessel in equal portions, but runs in ridges and veins; thus forming, though accidentally, the most curious and romantic figures, and often exhibiting a species of mosaic work of the most exquisite kind; figures which, instead of seeming the result of accident, appear to have been formed and elaborated by the most correct taste and the highest ingenuity. Our crystal, it has been conjectured, would answer the same purpose as these coarse agates; and as the preparation is simple, the art could without difficulty be carried into execution in Europe. Of these vessels, the ground is generally white, though sometimes blue; and the *only* difference in the preparation is this, that the vessels require two coats instead of one of the agate oil, and that before the second coat is applied, the blue colour must be imparted to them by immersing them in blue varnish.

ding. In addition to painting, porcelain is frequently ornamented with gilding; a process performed in a way similar to painting. The precipitate of gold, from its solution, is ground up with the oil of turpentine and a small quantity of the flux. With this preparation, the parts of the vessel to be gilt are covered; and are in this state put into the furnace as in painting. The fire causes the oxygen to fly off, the gold being left in its metallic form, firmly adhering to the porcelain. It now requires merely to be varnished; after which it assumes a rich, glossy, lively appearance. Platina is used in a similar way.

rnish- The only thing now that requires to be done with the porcelain, ere it be carried to the furnace, is oiling or varnishing; an operation of considerable delicacy, inasmuch as the varnish must be applied equally, and as if it exceed or fall under a certain quantity, the vessel is completely spoiled; and this quantity must be great or small according to circumstances; that is, according to the quality of the work, or their colour, or the colour of the figures and devices with which they are adorned. Of the oils of which the Chinese make their varnish, we have already spoken. These oils they mix together with great caution and delicacy; and, with an almost endless variety of other slight ingredients, form with them varnishes of every hue and every degree of fineness and elegance. The Chinese, though they have not for centuries made any real improvement in the art of porcelain manufacture, have recently discovered a new varnish of a brown goldish appearance; much esteemed, probably on account of its novelty. This varnish is made of a common yellow earth, which they dissolve in water, and of which, allowing the coarsest residuum to be thrown out as refuse, they make use only of the purest and finest parts. This, which is first in the form of a soft paste, and which is afterwards dissolved by a new admixture of water, is mixed, before it can be used, with the common varnish, and other subordinate ingredients, in just proportions. This varnish is applied by immersing the vessels in it; they are then removed to the oven; and the baking gives the most beautiful brightness to the colour.

Baking. After the porcelain has received, in the way described above, its proper shape, ornaments, and colour, it requires only to be baked to complete the whole operation. The ovens, in which the baking takes place, are formed of three kinds of earth; one yellow and common; the remaining two scarce, one of them called lautou, a strong stiff earth, the other youtou, oily. These ovens are about two fathoms in height and four in breadth, and their roof and wall are so thick and impervious, that even when the furnace is at the hottest, a person may place his hands on them with impunity. The dome or roof is shaped like a tunnel, with a large aperture at the top, and five smaller ones around, to allow the smoke and flames to escape. In each of the furnaces there is a long vestibule or porch for conveying air, which answers instead of bellows. When the fire is lighted, every entrance to the furnace is closed, with the exception of this vestibule, and of a small aperture of a foot in length, but very narrow, for the admission of wood, of which the fire is formed, and which two men, who release each other alternately, continue throwing in without intermission. Every piece of porcelain is inclosed in a separate case, called in Europe *saggars*, ere it be put into the furnace. The bottom of these cases is covered with a layer of fine sand, which is sprinkled over with the powder of the kaolin, to prevent the sand from adhering to the body of the vessel. These cases are arranged in files, the bottom of the one forming the cover of the other, so that the porcelain may not be subjected to the too direct action of the heat. And the difficulty at this step of the progress is, that they be so arranged, and the fire so managed, that the flame may have a free passage, and insinuate itself equally in every quarter of the furnace. To know when the porcelain is fully baked, the workmen open a small aperture, and with a pair of tongs take off one of the covers of the cases; and if the colour of the porcelain exhibit a bright lustre, and if all the piles seem equally inflamed, the coction is regarded as sufficient; and the fire being discontinued, the furnace is allowed to cool gradually before it is opened. Some species of porcelain are painted twice, and after having been in the oven just described, they are baked a second time in a smaller oven. Here they require no cases, the oven itself serving that purpose, being about a foot high and half a foot broad; and the object of this second baking (which takes place chiefly with tea-cups, and other similar elegant vessels) is either to render the lustre of the colours more brilliant, or sometimes, by covering them with colours, to remove blemishes which have taken place in some former stage of the process.

Vitrification. On the operation of baking depend the nature and characteristics of the porcelain manufactures. It is not at all difficult to procure earths and other ingredients that will exhibit nearly all the appearances of porcelain, ere it be subjected to the fire; but the great and distinctive property of porcelain is its semi-vitrification, to which it owes its lustre and transparency; a result which has not yet been *satisfactorily* attained with any other substances, but those of which the Chinese form their celebrated manufacture. M. Reaumur was the first who examined this subject scientifically. He analyzed the Chinese and European porcelains; he tried to ascertain their real and inherent qualities by the action of heat; and the result of his experiments was, that the properties of the two manufactures were essentially different; that European porcelain, when subjected to the fire, underwent perfect fusion; that the eastern porcelain was unaltered by the fire, and was a half-vitrified substance, in a middle state between the common baken earthenware of vulgar manufactures, and true glass. Other philosophers have since made this subject the object of scientific investigation, particularly the late Mr. Wedgewood, though the result of his experiments was not exactly the same as those of Reaumur. Mr. Wedgewood ascertained the fusibility of most of the European porcelains; that several kinds manufactured in England underwent perfect vitrification at temperatures from 90° of his scale to 120°; that one kind, manufactured at Bristol, showed no symptoms of vitrification at 135°; and that the Dresden porcelain was still more obstinate in resisting the heat. He also ascertained that common Chinese porcelain did not vitrify completely by any heat, but began to soften at 120°, and at 156° became so soft as to lose their shape; that the real King-te-tching porcelain did not soften in any heat that could be applied; but that, on the contrary, its internal substance, entirely unaltered, still retained its granular texture.—In a former part of this article, it was mentioned that earths have recently been discovered in different parts of Europe, possessing similar properties as those of China; and hence that our European porcelain has of late attained to very considerable perfection. The true and real porcelain seems to be formed when the fusible part requires the greatest degree of heat for that purpose. This is the case with the petuntse of the Chinese, which is allowed to be similar to, if not the same as the feldspar of Cornwall. The other ingredient, to which the porcelain mass owes its ductility, is called porcelain-clay or earth, which is a substance composed of alumina and silex, in various proportions, and which corresponds in no inconsiderable degree with the kaolin of the east. In Europe, the substance known by the name of soap-rock or steatite, is employed with the kaolin or porcelain clay, with the view of giving firmness to the infusible part of the manufacture.—Such being our advantages, we may hope soon to rival the celebrated porcelain manufacture of the east; though probably, even allowing we have the materials, centuries may elapse ere our workmen attain to that surprising degree of delicacy, ingenuity, and accuracy, in conducting the different steps of the progress, for which the Chinese labourers have, for time immemorial, been so celebrated; and without which all the other advantages we possess can be of no avail.

The foregoing discussions, however, have had a reference almost entirely to the porcelain of the Chinese, and to the art of manufacturing it as practised by that ancient and celebrated people. European porcelains, and the ingredients of which they are made, have been mentioned but collaterally, and as by no means exhausting the subject. The materials in this portion of the world being naturally different substances, and exhibiting different features from those of China (though they are not widely different in inherent radical properties) necessarily undergo a process of preparation and management considerably dissimilar from those that obtain in the east. For this reason, and because every kind of porcelain manufactured in Europe, particularly what is denominated soft porcelain, are in every respect so analogous to pottery (of which indeed they may be regarded a species) both in internal ingredients, and in the mode in which they are formed, baked, glazed, and printed, that we beg leave to refer our refers to that article for suitable information on this subject.

For Reaumur's articles on this subject, see *Mémoires de l'Académie des Sciences*, 1727—1729; for Scheffer's, *Swedish Transactions*, 1753; for Guettard's, *Mém. de l'Acad. des Sciences*, 1766. See Macquer's *Chemical Dictionary*; Nicholson's *Journal*, vols. iii. xii.; *Philosophical Magazine*, vol. iii.; *Annals of Philosophy*, vol. iii.; Murray's *System of Chemistry*, vol. iii. See also in this work the articles POTTERY and WEDGEWOOD. (&)

PORCHESTER, a village of England, in Hampshire, is about a mile long, extending along the road towards Fareham. It is celebrated chiefly for its ancient castle, built on a neck of land in the middle of Portsmouth harbour, and consisting of a series of walls and towers, covering an area of about five acres. It served during the late war as a prison for between 3000 and 5000 prisoners. The castle exhibits specimens of Roman, Saxon, and Norman architecture, and it seems to have been in the possession of the Roman General Vespasian. A full account of it will be found in the *Beauties of England and Wales*, vol. vi. p. 303.

PORISMS.*

PORISMS are a species of proposition in geometry much employed by the ancients: they appear to have been highly valued, and to have assisted them greatly in their geometrical researches. The name is almost all that remains to us of their labours, and although, from the singularly curious nature of the subject, and the facilities they afford in the cultivation of every branch of geometrical science, it is improbable that the subject should have occupied the attention of only a single author, yet we are acquainted with but one geometer among the ancients who composed a work expressly on the subject, and, unfortunately for the science, the whole of that work is lost, if we except a small fragment preserved by Pappus, in such an imperfect manner, as almost to have rendered hopeless any divination of its meaning. The three books on Porisms, by the author of the *Elements of Geometry*, form the only work expressly devoted to this subject, whose title has been handed down to us; and even the meaning of the word Porism was involved in considerable obscurity. Pappus Alexandrinus, through whom alone we derive any information on this subject, has given two definitions of the word Porism; the first he blames as insufficient, because it might include some *loci*, and the second, which he adopts, is so general and indefinite, as to convey to us no precise knowledge of their nature.

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* The Editor has been indebted for this interesting article to CHARLES BABBAGE, Esq. F.R.S. L. and E. &c.

In the abstract he has given of the labours of those who preceded him, he has mentioned the three books on Porisms by Euclid, and has given thirty-eight geometrical propositions, of no very considerable difficulty, as useful for the comprehension of the work itself. These, together with the imperfect definition, and an example of a porism which refers to a figure that is lost, and which is so remarkably confused as almost to render its reconstruction impossible, are all the data that remained. From these materials modern geometers have attempted to restore the work of Euclid; and although the task is one of extreme difficulty, yet, when executed, a very probable estimate may be formed of its resemblance to the original.

Albert Girard, in a work on trigonometry, printed at the Hague in 1629, mentions the lost books of porisms, and says that he had made a restoration of them: and again, in an edition of the works of Stevinus,* he declares that he had reinvented the porisms of Euclid, and intended shortly to publish them. Unfortunately he died before this intention was accomplished. As the works of Stevinus were printed by his widow after his death, possibly the manuscript may still exist in some of the libraries in Holland. From the subsequent discoveries of Dr. Simson, however, it appears that the idea which Girard had of the species of propositions to which he annexed the name of porisms, was by no means the same as that which the former writer has so ably proved to have been attached to it by the ancient geometers.

After Girard, the next attempt to explain the nature of porisms was made by Bullialdus;† but this seems to have been derived from a communication with Fermat, to which distinguished mathematician we must now advert. Amongst his posthumous works‡ is a short paper, entitled, "*Porismatum Euclidæorum renovata doctrina*," from which it appears that he had approached nearer than any of his predecessors to the true meaning of this class of propositions; and, in fact, several of those with which he illustrates his view of the subject are in reality porisms: but he did not arrive at any definition which should clearly separate porisms from local theorems, nor did he even conjecture that there existed some peculiar mode of analysis by which such propositions might be discovered, nor attempt to restore any of those of Euclid; his promised restoration of the whole of the three books never having been published.

Dr. Halley, who possessed an extensive and profound acquaintance with the ancient geometry, made some attempts to decypher the enunciation of the porism given by Pappus. He had successfully restored the 8th book of the conics of Appollonius, and the two books of the same author, *De Sectione Spatii;* and had achieved a still more difficult labour, that of translating from the Arabic (a language with which he was unacquainted) the work of Apollonius *De Sectione Rationis;* yet he was baffled by the obscurity which pervaded the mutilated description of Pappus, and observes, "Hactenus Porismatum descriptio nec mihi intellecta nec lectori profutura."

The failure of all who preceded in elucidating this obscure subject, as well as the high rank which Pappus assigned to these propositions, seems to have stimulated the curiosity of one whose unabated perseverance has been rewarded by complete success. Dr. Robert Simson has described the progress he made in this subject, in a way which cannot fail to interest the attention of those who have devoted even a small portion of their time to geometrical inquiries. "Postquam vero apud Pappum legeram porismata Euclidis collectionem fuisse artificiosissimam multarum rerum, quæ spectant ad analysin difficiliorum et generalium problematum, magno desiderio tenebar, aliquid de iis cognoscendi; quare sæpius et multis variisque viis tum Pappi propositionem generalem mancam et imperfectam, tum primum, lib. 1. Porisma quod solum ex omnibus in tribus libris integrum adhuc manet, intelligere et restituere conabar; frustra tamen, nihil enim proficiebam. Cumque cogitationes de hac re multum mihi temporis consumpserint, atque molestæ admodum evaserint, firmiter animum induxi hæc nunquam imposterum investigare; præsertim cum optimus geometra Halleius spem omnem de iis intelligendis abjecisset. Unde quoties mente occurrebant, toties eas arcebam. Postea tamen accidit, ut improvidum et præpositi immemorem invaserint, meque detinuerint donec tandem lux quædam effulserit, quæ spem mihi faciebat inveniendi saltem Pappi propositionem generalem, quam quidem multa investigatione tandem restitui.

"Descriptio autem quam tradit (*Pappus*) porismatum adeo brevis est et obscura, et injuria temporis aut aliter vitiata, ut nisi Deus benigne animum et vires dederit in ea pertinaciter inquirere, in perpetuum forsan geometris latuisset." Simsoni *Opera Reliqua*, p. 513.

Dr. Trail, in his life of Simson, gives the following account of the discovery.

"Dr. Simson maintained for some time his resolution of abstaining from all attempts at the rediscovery of porisms; but happening one day to be walking with some friends on the banks of the river Clyde at Glasgow, and by accident being left behind his company, he inadvertently fell into a reverie respecting porisms.

"Some new ideas struck his mind, and with his chalk having drawn some lines on an adjoining tree, at that moment, for the first time, he acquired a just notion of one of Euclid's porisms."§

The first publication of Simson on this subject, was a paper inserted in the *Philosophical Transactions* for the year 1723; it was not, however, until after his death, that the whole of his investigations were made public in the posthumous edition of his works, for which the mathematical world is indebted to the munificence of the late Earl Stanhope. Some few years after, this subject attracted the attention of Mr. Playfair, who has given a most philosophical account of the origin of this class of propositions, and has removed whatever obscurity remained attached to them. The paper in which his views are explained, is indeed a model of that peculiarly beautiful style of writing for which he was so justly celebrated, and which is unfortunately so rarely met with in the literary productions of mathematicians.

In the geometrical explanation of porisms, we shall avail ourselves of the light which he has thrown on the subject, and then endeavour to supply those observations which he promised respecting their algebraical investigation.

The definition of porisms which Simson has given,

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* Œuvres de Simon Stevin, par A. Girard. Lugd. Bat. 1634.

† Exercitationes Geometriæ. Parisiis, 1667.

‡ Fermat Opera Varia, p. 116. Tolosæ, 1679.

§ *Transactions of the Royal Society of Edinburgh*, 1793, vol. iii.

is unquestionably rather obscure; and without an example of one of these propositions, it is by no means easy to comprehend its meaning: it appears therefore preferable to postpone the explanation of the term until the reader is made acquainted with the thing. The ancient geometers examined every problem on which they bestowed their attention with the most minute scrutiny: unacquainted with the comprehensive generalization which is introduced into every geometrical problem by the application of algebra, they carefully inquired into every separate case that could cause any change in the magnitude or relative position of the data, fearful lest that mode of solution they had contrived for it in one case, might not equally apply to others. Such a laborious course of inquiry, although adverse to rapid advancement, was well calculated to make them perfectly acquainted with every thing remarkable which the solution of the problem could present; and it must soon have occurred to them, that in many cases the general construction would fail, and no solution be obtained, in consequence of some peculiar relation between the data. Such is the case if we attempt to divide a given line into two parts, whose rectangle is equal to a given square. When the given square is greater than that described on half the given line, no solution can be obtained. In such cases, the problem became impossible, and it was always found that some two at least of the data were contradictory to each other. In the illustration, we have chosen the two conditions, defining the magnitude of the line and that of the rectangle of its segments are incompatible.

When a problem contained an impossible case, another question presented itself; to determine the limits amongst the relations of the data, so that it shall just remain possible; and with respect to the problem itself, to construct it so that a certain quantity, instead of being given, shall be the greatest or least possible. The elegant constructions to which this gave rise, under the name of maxima and minima, are well known to geometers.

These circumstances would occur when the data were but few, and the problem simple; but in the consideration of questions a little less elementary, it must have been observed, that besides this method, by which the construction became useless, another of quite an opposite nature was sometimes introduced. It might happen that two lines or two circles by whose intersection the point ought to be determined, instead of cutting each other as in the general case, or not intersecting each other at all, as in the impossible one, should wholly coincide. The true interpretation of this circumstance could not long remain unnoticed. Since that point, which was common to the two lines, determined the point to be found, and in the case of two circles intersecting, there were two points in common, and therefore equally fulfilling the condition, it was natural to conclude, that when the lines or circles coincided, all points being in common, all would equally satisfy the problem. Here, then, an infinity of solutions appeared, yet they were all connected by a certain law. The reason of such a singular result, must soon have been found in the coincidence between two of the data, and thus a less number of data being given than were sufficient, the problem became indeterminate.

These curious cases would, of course, become objects of research, from the great facilities they afforded for the solutions of the problems to which they belonged, and the elegance which they introduced into them; and partaking in some measure of the nature of problems, as well as of theorems, they formed an intermediate class of propositions of great importance; to which, when enunciated in a peculiar manner, the name of porisms was attached.

As an example of the manner in which a porism might be discovered, we shall consider the following problem.

A circle ABC, Plate CCCCLVII. (Fig. 1.) a straight line DE, and a point F, being given in position, to find a point G in the straight line DE, such that GF, the line drawn from it to the given point, shall be equal to GB, the line drawn from it touching the given circle.

Plate
CCCCL
Fig. 1.

Suppose the point G to be found, and GB to be drawn touching the circle ABC in B; let H be the centre of the circle ABC; join HB, and let HD be perpendicular to DE; and from D draw DL, touching the circle ABC in L, and join HL. Also, from the centre G, with the distance GB or GF, describe the circle BKF, meeting HD in the points K and K′.

It is plain that the lines HD and DL are given in position and in magnitude. Also, because GB touches the circle ABC, HBG is a right angle, and G is the centre of the circle BKF; therefore HB touches the circle BKF, and consequently the square of HB or of HL is equal to the rectangle K′HK. But the rectangle K′HK, together with the square of DK, is equal to the square of DH, because KK′ is bisected in D; therefore the squares of HL and DK are also equal to the square of DH. But the squares of HL and LD are equal to the square of DH; wherefore, the square of DK is equal to the square of DL, and the line DK to the line DL. But DL is given in magnitude, therefore DK is given in magnitude, and K is therefore a given point. For the same reason, K′ is a given point, and the point F being also given by hypothesis, the circle BKF is given in position. The point G, therefore, the centre of the circle BKF, is given, which was to be found.

Hence this construction: Having drawn HD perpendicular to DE, and DL touching the circle ABC, make DK and DK′ each equal to DL, and find by the centre of a circle described through the points K, F and K′, that is, let FK′ be joined, and bisected at right angles by the line MN, which meets DE in G; G will be the point required, or it will be such a point, that if GB be drawn from it, touching the circle ABC, and GF to the given point, GB and BF will be equal to one another.

In this instance, we have a problem which admits in general but of one solution, since only one circle can pass through three given points; yet if the point F which is given should coincide with either of the two points K or K′ which are found, it is evident that an infinite number of circles can pass through two given points, and their centres will be situated on a right line perpendicular to the middle point of the line which joins them: in this case, then, the problem becomes indeterminate, since any point in that line will satisfy the conditions.

The indeterminate case is thus enunciated as a porism.

A circle ABC being given by position, and also a straight line DE, which does not cut the circle, a point K may be found such, that if G be any point whatever in the line given, the straight line drawn from G to the point K shall be equal to the straight line drawn from G touching the circle ABC. This is in fact the

66th proposition in Dr. Simson's restoration, slightly altered in its statement.

As another instance of a problem leading to a porism, we will give one which appears to have led to the invention of the second porism in the treatise of Simson.

rF. LXVII. 2.

A circle ABC, (Fig. 2.) and two points D and E, in a diameter of it being given, to find a point F in the circumference of the given circle, from which, if straight lines be drawn to the given points E and D, these straight lines shall have to one another the given ratio of α to β.

Suppose the problem resolved, and that F is found, so that FE has to FD the given ratio of α to β. Produce EF any how to B, bisect the angle EFD by the line FL, and the angle DFB by the line FM.

Then because the angle EFD is bisected by FL, EL is to LD as EF is to FD, that is in a given ratio; and as ED is given, each of the segments EL, LD is given, and also the point L.

Again, because the angle DFB is bisected by FM, EM is to MD as EF to FD, that is in a given ratio; and therefore since ED is given, EM, MD, are also given, and likewise the point M.

But because the angle LFD is half of the angle EFD, and the angle DFM half of the angle DFB, the two angles LFD, DFM, are equal to the half of two right angles, that is to a right angle. The angle LFM being therefore a right angle, and the points L and M being given, the point F is in the circumference of a circle described on the diameter LM, and consequently given in position.

Now, the point F is also, in the circumference of the given circle ABC: it is therefore in the intersection of two given circumferences, and therefore is found.

Hence the following construction: Divide ED in L so that EL may be to LD in the given ratio of α to β, and produce ED also to M, so that EM may be to MD in the same given ratio of α to β. Bisect LM in N, and from the centre N, with the distance NL, describe the simicircle LFM, and the point F in which it intersects the circle ABC, is the point required, or that from which FE and FD are to be drawn.

It must, however, be remarked, that the construction fails when the circle LFM falls either wholly without or wholly within the circle ABC; so that the circumferences do not intersect; and in these cases the solution is impossible. It is plain also that in another case the construction will fail, namely, when it so happens that the circumference LFM wholly coincides with the circumference ABC. In this case it is farther evident, that every point in the circumference ABC will answer the conditions of the problem, which therefore admits of innumerable solutions.

The indefinite case of this proposition thus enumerated becomes a porism.

g. 3.

A circle, ABC, (Fig. 3.) being given, and also a point D, a point E may be found, such that two lines, DF and EF, inflected from these points to any point F in the circumference of the circle, shall have to each other a given ratio, which ratio may be found.

From these examples, the definitions which have been given of the term porism will be better understood than by merely considering the words in which they are expressed. Dr. Simson has thus described them: "Porisma est propositio in qua proponitur demonstrare rem aliquam, vel plures datas esse, cui, vel quibus, ut et cuilibet ex rebus innumeris, non quidem datis, sed quæ ad ea quæ data sunt eandem habent relationem, convenire ostendendum est affectionem quandam communem in propositione descriptam."

The obscurity of this definition is such, that nothing but a comparison with an example can make it intelligible; that of Playfair is much happier, and is thus expressed: *A porism is a proposition, affirming the possibility of finding such conditions as will render a certain problem indeterminate.*

This latter has the advantage of indicating the course to be pursued in the discovery of porisms; for in the first case the problem was rendered indeterminate by making two out of the three points, which determined the position of a circle, coincide; and in the last example, the coincidence of two circles, whose intersections should have determined the point required in the problem, rendered it indeterminate. This mode of analysis, for the discovery of porisms, has one disadvantage, that it supposes the solution of the problem to be first found; that which was contrived by Simson is free from this objection, and when abridged by the considerations which Playfair has introduced, is admirably adapted to its object.

It may be observed, that the points or magnitudes required may generally be discovered by considering the extreme cases; but that the relation between these and the indefinite magnitudes cannot be arrived at by such limited considerations. The difference between a locus, a local theorem, and a porism, are well illustrated by Playfair in the various modes of enunciating the truth discovered in the second of the two propositions we have given.

PLATE CCCCLXVII. Fig. 3.

Thus, when we say, if from two points, E and D (Fig. 3.) two lines, EF, FD, are inflected to a third point F, so as to be to one or other in a given ratio, the point F is in the circumference of a circle given in position: we have a locus. But when conversely, it is said, if a circle ABC, of which the centre is O, be given in position, as also a point E, and if D be taken in the line EO, so that the rectangle, EO, OD, be equal to the square of AO, the semidiameter of the circle; and if from E and D, the lines EF and DF be inflected to any point whatever in the circumference ABC; the ratio of EF to DF will be a given ratio, and the same with that of EA to AD: we have a *local theorem.*

And, lastly, when it is said, if a circle ABC be given in position, and also a point E, a point D may be found, such that if two lines EF and FD be inflected from E and D to any point whatever F, in the circumference, these lines shall have a given ratio to one another: the proposition becomes a porism, and is the same we have just investigated.

The algebraical method for the investigation of porisms, may very readily be deduced from the consideration of the definition which Playfair has given, and the facilities which such a method presents in the discovery of this class of truths, is another instance of the advantages which result from a condensed method of expressing the relations of quantity. It has been stated, that *a porism is a proposition affirming the possibility of finding the indeterminate case of a problem.*

If, therefore, any problem is proposed in which the quantity sought is called x; by means of the given conditions some equation will be found between x and known quantities, which may be reduced to the form

$$A + Bx + Cx^2 + \ldots + Nx^n = 0 \qquad (\alpha)$$

A, B, . . . being known functions of the constant quantities; from this equation x may be determined, or at least it cannot generally have more than a certain determinate number of values; such values of x satisfy the conditions of the problem; but in order to discover whether any porismatic case exists, we must examine whether the data of the problem admit of such a relation amongst themselves, that we may have at the same time

$$A = B = C = \ldots = N = 0.$$

If this is the case, the equation (a) is verified independently of any particular value of x; and, instead of a limited, we have an indefinite number of solutions. This principle may be stated more generally thus, if $a, b, c, \ldots$ are given quantities, and $x, y, z, \ldots$ those which are to be found; then the solution of the problem leads to several equations of the form

$$F(x, y, \ldots a, b, \ldots) = o.$$

If any relation which can be established amongst the constants $a, b, c, \ldots$ shall cause the equation which results from the elimination of the unknown quantities from these equations to be independent of any of them, then by supposing that relation to exist we have a porism.

PLATE CCCCLXVII. Fig. 4.

As an example, let us take the following problem. Suppose a circle (Fig. 4.) whose radius is r, and a point C in its diameter, such that $OC = v$, also a straight line, FL, perpendicular to this diameter; let it be required to find the angle which the chord, PQ, must make with the diameter; so that if another chord, $P_{,}Q_{,}$, be drawn at right angles to it, and from the extremities of these chords perpendiculars be drawn to the given line, the rectangle under those let fall from one chord on this line shall be equal to that under the perpendiculars let fall on the same line from the other chord. Let the required angle $PCF = \theta$, then

$$CE = v \cos. \theta \text{ and } OE = v \sin. \theta$$

$$\text{Hence } CP = \sqrt{r^2 - v^2 \sin. \theta^2} - v \cos. \theta$$

$$CQ = \sqrt{r^2 - v^2 \sin. \theta^2} + v \cos. \theta.$$

$$\text{Also } CG = \frac{a-v}{\cos. \theta}$$

$$\text{Therefore } PG = \frac{a-v}{\cos. \theta} + v \cos. \theta \pm \sqrt{r^2 - v \sin. \theta^2}$$

$$QG = \frac{a-v}{\cos. \theta} + v \cos. \theta \pm \sqrt{r^2 - v^2 \sin. \theta^2}$$

These multiplied by cos. θ produce respectively

$$PL = a - v + v \cos. \theta^2 \pm \cos. \theta \sqrt{r^2 - v^2 \cos. \theta^2}$$

$$QM = a - v + v \cos. \theta^2 \pm \cos. \theta \sqrt{r^2 - v^2 \cos. \theta^2}$$

The rectangle under these two lines is

$$(a - v + v \cos. \theta^2)^2 - \cos. \theta^2 (r^2 - v^2 \sin. \theta^2$$

And this by proper reductions becomes

$$PL \,.\, QM = (a-v)^2 + \begin{pmatrix} 2av - v^2 \\ - r^2 \end{pmatrix} \cos. \theta^2$$

In order to find the rectangle of the perpendiculars let fall from the extremities of another chord at right angles to this, we have only to change θ into $\frac{\pi}{2} + \theta$ in this expression, and since $\cos.\left(\frac{\pi}{2} + \theta\right) = \sin. \theta$ we must substitute $1 - \cos. \theta^2$, instead of $\cos. \theta^2$, which gives

$$P_{,}L_{,} . Q_{,}M_{,} = a^2 - r^2 - \begin{pmatrix} 2av - v^2 \\ - r^2 \end{pmatrix} \cos. \theta^2$$

And since these two quantities must be equal by the conditions of the problem, we have the following equation for determining cos. θ,

$$\left\{ \begin{matrix} (a-v)^2 \\ -a^2 + r^2 \end{matrix} \right\} + \left\{ \begin{matrix} 2av - v^2 \\ - r^2 \\ 2av - v^2 \\ - r^2 \end{matrix} \right\} \cos. \theta^2 = 0 \qquad (1)$$

The solution of this equation gives

$$\cos. \theta = \pm \frac{1}{\sqrt{2}}$$

or $\theta = \pm \frac{\pi}{4}$, which evidently satisfies the condition; but there exists a possible relation amongst the quantities a, v, and r, which will fulfil the equation (1) without determining the value of cos. θ, for that equation is the same as

$$\left(\overline{a-v}^2 - a^2 + r^2\right) -^2 \left(\overline{a-v}^2 - a^2 - r^2\right) \cos. \theta^2 = 0;$$

and by assuming,

$$\overline{a-v}^2 - a^2 + r^2 = 0, \text{ or } v = a \pm \sqrt{a^2 - r^2};$$

this equation is verified independently of the value of cos. θ. Here then is an indeterminate or porismatic case, and the porism so discovered may be thus enunciated.

A circle and a straight line being given in position, a point may be found within the circle, such, that if any two chords are drawn through that point at right angles to each other, the rectangle under the perpendiculars, let fall from the extremities of the first chord to the line given in position, shall always be equal to the rectangle under the perpendiculars let fall from the extremities of the other chord on the same line.

If the problem had been to find the angle which the first chord should make with the diameter, that the sum of the squares of the perpendiculars from the first chord should be equal to the sum of the squares of the perpendiculars from the extremities of the second chord, we should have found

$$PL^2 + QM^2 = 2(a-v)^2 + 2\begin{pmatrix} 2av - 3v^2 \\ + r^2 \end{pmatrix} \cos. \theta^2 + 4v^2 \cos. \theta^4;$$

and putting $\frac{\pi}{2} + \theta$ for θ, and making the proper reductions $P_{,}L_{,}^2 + Q_{,}M_{,}^2 = 2(a^2 + r^2) - 2(^2av + v^2 + r^2) \cos. \theta^2 + 4v^2 \cos. \theta^4$;

and the equation determining cos. θ, is,

$$\left(\overline{a-v}^2 - a^2 - r^2\right) + \begin{pmatrix} 2av - 3v^2 + r^2 \\ 2av + v^2 + r^2 \end{pmatrix} \cos. \theta^2 = 0;$$

$$\text{or, } \left(\overline{a-v}^2 - a^2 - r^2\right) - 2\left(\overline{a-v}^2 - a^2 - r^2\right) \cos. \theta^2 = 0;$$

this, like the former, gives $\theta = \pm \frac{\pi}{4}$: but here also an indeterminate case exists, and may be found by making the coefficients vanish. The equation $\overline{a-v}^2 - a^2 - r^2 = 0$, gives $v = a \pm \sqrt{a^2 + r^2}$; and this value of v verifies the equation independently of the magnitude of cos. θ. This porism may be enunciated as follows.

A circle and a right line being given in position, a point may be found within the circle, such that drawing through it any two chords at right angles to each other, the sums of the squares of the perpendiculars from the extremities of the first chord to the given line, may be equal *to the sums of the squares of the perpendiculars drawn from the extremes of the other chord to the given line.*

It is proper to observe, that in both these cases the lower sign must be employed, otherwise the point found will not be within the circle. In retranslating algebra into geometry, it frequently happens that only some one of the roots which satisfy the conditions of the problem algebraically, will fulfil the geometrical conditions.

In both examples which have been given, the equation determining the value of the unknown quantity, was multiplied by a factor independent of it; thus the first equation may be put under the form

$$\left\{\overline{a-v}^2-a^2-r^2\right\}\times\left\{1-2\ \cos.\ t^2\right\}=0;$$

and the second,

$$\left\{\overline{a-v}^2-a^2-r^2\right\}\times\left\{1-2\ \cos.\ t^2\right\}=0;$$

and as these equations contain all the conditions of the respective problems, provided they are verified, solutions will be found. If the relation amongst the quantities a, v, r is such that the first factor vanishes, it is evident that the equations are, in all cases, verified, without assigning any particular values to cos. t.

This evanescence of a factor is not, however, the only cause which produces porismatic cases, as will appear in several of the subsequent examples.

The following problem leads to a porism, which is already well known by the writings of Simson and Playfair. To show how it might have been discovered by the algebraic method, will not therefore be without interest.

A circle and a straight line being given, and also a point in that diameter of the circle which is perpendicular to the given line, it is required to find a point in the given line, such that if a line be drawn through it, and the given point cutting the circle, then the rectangle under the segments of that line contained between the points found and the circle, shall be a given multiple of the square of the line joining the two points.

Employing the same notation and letters as in the figure 4, let G be the point required; then G will be determined by the angle t, which the line CG makes with the diameter; and the values of the several lines will be as follows:

$$\mathrm{PG}=\frac{a-v}{\cos.\ t}+v\cos.\ t\pm\sqrt{r^2-v^2\sin.\ t^2}$$

$$\mathrm{QG}=\frac{a-v}{\cos.\ t}+v\cos.\ t=\sqrt{r^2-v\ \sin.\ t^2}$$

$$\mathrm{CG}=\frac{a-v}{\cos.\ t}$$

Hence the equation expressing the condition is

$$\left(\frac{a-v}{\cos.\ t}+\cos.\ t\right)^2-r^2+v^2\sin.\ t^2=n\left(\frac{a-v}{\cos.\ t}\right)^2$$

Or,

$$(1-n)\left(\frac{a-v}{\cos.\ t}\right)^2+2v(a-v)-r^2+v^2=0$$

where n is the given multiple. From this equation the angle t may easily be found, and consequently the position of the point G may be determined. But if $n=1$, the angle altogether disappears from the formula, and it can only be satisfied by supposing

$$2av-v^2-r^2=0$$

$$\text{or,}\quad v=a\pm\sqrt{a^2-r^2}$$

If this relation take place amongst the data, any value of t will fulfil the condition; but if it does not, no value can satisfy it.

Observing that the rectangle under the segments of the line is equal to the square of the tangent to the circle, we have the following porism.

Plate CCCCLXVII. Fig. 5.

A circle and a right line GE (Fig. 5.) *being given, a point* C *may be found within the circle, such that, if from any point* G *in the given line a tangent* GP *be drawn to the circle, and also if that point* G *and the point found* C *be joined, the line* CG *joining these points shall be equal to the tangent to the circle* GP.

This porism is similar to propositions 63 and 66 of Simson's restoration, and is one of the illustrations made use of in the paper of Playfair. It would be easy to investigate, by this method, many other of the porisms of Euclid; but since it is proposed as a method of invention, it will be more satisfactory to employ it in the discovery of new ones. We shall therefore proceed to investigate a few others.

A circle being given, and also a line, and a point situated in the line drawn from the centre, perpendicular to the given line, and the quantities a, v, r, &c. remaining the same as in the previous questions, if a chord is drawn through the given point, and from its extremities perpendiculars are drawn to the given line, we shall have (in Fig. 4.)

$$\mathrm{PL}=a-v+v\cos.\ t^2\mp\cos.\ t\sqrt{r^2-v^2\cos.\ t^2}$$

$$\mathrm{QM}=a-v+v\cos.\ t^2\pm\cos.\ t\sqrt{r^2-v^2\cos.\ t^2}$$

and the sum of these two perpendiculars, or

$$\mathrm{PL}+\mathrm{QM}=2(a-v+v\cos.\ t^2)$$

which is independent of the value of r, or of the magnitude of the radius of the circle.

This circumstance allows us to enunciate this truth as a very simple porism.

Fig. 6.

Two lines making a given angle with each other GQ *and* GM (Fig. 6.) *being given, a point* O *may be found in one of them, such that if about that point as a centre, a circle with any radius be described cutting one of the given lines in two points* P *and* Q, *the sum of the perpendiculars drawn from these points to the other line shall be equal to a given line.*

If FS perpendicular to GM be made equal to half the line to which the sum of the two perpendiculars is equal, and if SO be drawn perpendicular to GQ, any point O may be taken as the centre of the circles.

In Fig. 7. the same notation being preserved, the sum of the perpendiculars is

$$\mathrm{PL}+\mathrm{QM}=2(a-v+v\cos.\ t^2)$$

Let some other point $\mathrm{C}_{\prime}$ be taken, $\mathrm{OC}_{\prime}=v'$, and a chord be drawn parallel to the former, then the sum of the perpendiculars drawn from the extremities of this chord is

$$\mathrm{P}_{\prime}\mathrm{L}_{\prime}+\mathrm{Q}_{\prime}\mathrm{M}_{\prime}=2(a-v'+v'\cos.\ t^2)$$

Let us now determine the value of cos. t, so that the former sum shall differ from n times the latter by a constant quantity $2c$, the resulting equation is

In the same figure, the sums of the squares of the perpendiculars are represented by

$$2(a-v)^2 + 2(2av - 3v^2 + r^2)\cos.\,\theta^2 + 4v^2\cos.\,\theta$$

$$2(a-v)^2 + 2(2av - 3v^2 + r^2)\cos.\,\overline{\theta + \frac{2\pi}{2}}^{\,2} +$$

$$4v^2\cos.\,\overline{\theta + \frac{2\pi}{n}}^{\,4}$$

$$2(a-v)^2 + 2(2av - 3v^2 + r^2)\cos.\,\overline{\theta + \frac{2n-2}{n}\pi}^{\,2} +$$

$$4v^2\cos.\,\overline{\theta + \frac{2n-2}{n}\pi}^{\,4}$$

And the sums of the vertical series being found by means of the formula already given, we have for the sum of the squares

$$2n(a-v)^2 + n(2av - 3v^2 + r^2) + \frac{3n}{2}v^2,$$

which is independent of the value of θ; it may therefore be enunciated thus:

A circle and a right line being given in position, and also a square being given; a point within the circle may be found, such that if through the point found a given number n *of chords be drawn, making equal angles with each other, and from their extremities perpendiculars be drawn to the given line, the sum of the squares of all these perpendiculars shall be equal to the square which is given.*

In this, as in many of the preceding propositions, the given quantities must be contained within certain limits, otherwise they may become impossible: these limits will always be pointed out distinctly by the algebraic analysis.

The theorems relating to the sums of series of the powers of sines or cosines of arcs in arithmetical progression, which have been noticed in a former page, are of very extensive use in the discovery of porisms. In fact, whatever line (whether relating to the circle or ellipse, or to any other combination of lines or curves,) can be expressed in a rational integral form, with respect to the powers of the sine or cosine, if only the angle be continually increased by some aliquot part of the circumference, until it returns into the first line; then the sum of all these lines will be constant, as will also the sums of any powers of such lines.

The explanation which has been given of the method of applying algebraic reasoning to the discovery of the most elegant class of geometrical propositions, will, it is presumed, have demonstrated that this instrument of investigation is at least as fertile in the number of the conclusions to which it leads, as that analysis which was contrived by the celebrated restorer of the lost books of Euclid. In comparing the time and attention which must be expended in employing the geometrical method with that which is requisite for the complete success of the algebraic analysis, the superior value of the latter is strikingly pre-eminent; and if, by adding to the number of these propositions, any considerable benefit would accrue to the science, that number might easily be enlarged to an unlimited extent. Such, however, is not the case; and it must be acknowledged that these truths, in their geometrical form, are useful only for the purpose of cultivating those mental habits which mathematical studies tend so strongly to promote. Signs and figure are less abstract than mere number, and are therefore more easily conceived, and their relations more calculated to excite and fix the attention: this, together with the imperfection of those instructions which are usually given to the learner at the commencement of his algebraic studies, seems to be the real ground of the asserted superiority of geometrical over algebraical reasoning, for the purpose to which we have alluded.

PORSON, Richard, a celebrated Greek scholar, was born at East Ruston in Norfolk, on the 25th Dec. 1759. He was the son of Mr. Huggin Porson, the parish clerk, who taught him arithmetic, reading, and writing. He learned the alphabet by tracing the letters upon sand, or upon a board; and he acquired his arithmetic without the aid of a book or slate.

In the ninth year of his age he was sent along with his brother Thomas to the village school, kept by Mr. Summers, under whom he continued three years. The Rev. Mr. Hewitt, having heard of his uncommon proficiency in arithmetic and other elementary studies, undertook to instruct Richard in classical knowledge; and Mr. Norris, a neighbouring country gentleman, was at the expence of sending him to Eton in 1772. By the death of Mr. Norris, he was thrown upon the liberality of some friends, particularly Sir George Baker, who took him into his house during the vacation, and by receiving small subscriptions, purchased an annuity of £80 per annum, for a few years, so as to enable him to remain at Eton. At this seminary he was distinguished for his diligence and classical attainments, but particularly by his extraordinary memory, which enabled him to bring forward all that he had read. The receipt of a copy of Toup's Longinus, given him as a reward for a good exercise, is said to have first given him a decided turn for critical enquiries.

Towards the end of the year 1777, he was sent to Trinity College, where he obtained the classical prize medal, and the university scholarship. In 1781 he obtained a fellowship in Trinity College, and in 1785 he took his degree of master of arts. He declined, however, to sign the Thirty-nine Articles; and being thus unable to take orders, he was necessarily deprived of his fellowship in 1791. By means of a subscription, an annuity of £100 during his life was purchased for him, and the addition of £40 per annum was made to his income, by his appointment to the professorship of Greek at Cambridge. He was married in the year 1795, but losing his wife in 1797, his own health was observed to decline. A spasmodic asthma, increased by irregularity in his mode of life, interrupted in a serious manner the laborious studies which he had been in the habit of pursuing.

Upon the establishment of the London institution, he was appointed principal librarian, with a salary of £200 per annum; but he did not long enjoy this comfortable sinecure. His former complaint renewed its attacks, and weakened his frame; and in consequence of an apoplectic stroke, he expired on the 25th September, 1808, in the forty-ninth year of his age. His body was removed to Cambridge, where it was received by the Bishop of Bristol with every mark of respect, and interred in the chapel of Trinity College, near the remains of Bentley.

The principal writings of Porson are, his letters to Mr. Archdeacon Travis, in answer to his Defence of the Three Heavenly Witnesses; his MSS. of Photius's Lexicon, which appeared at Cambridge in 1822, and his four plays of Euripides, with the prefaces, viz. *Hecuba*, which appeared at London in 1797: *Orestes*, Lond. 1798, 1811; *Medea*, Cambridge, 1801, Lond. 1812. The whole together appeared at London in 1822.

The rest of Porson's works, which are numerous, consist chiefly of criticisms on celebrated passages of ancient authors. See Weston's *Account of the late Mr. Richard Porson*, Lond. 1808, 8vo.; and Kidd's *Imperfect Outline, &c.*

PORT-MAHON. See MINORCA.

PORTA-BAPTISTA, or GIAMBAPTISTA, a celebrated Neapolitan philosopher, was born about the year 1545. Attached to the study of nature from an early period of his life, he evinced an uncommon zeal for the advancement of knowledge. Having established in his house a kind of academy, called *De Secreti*, he admitted only those who had made some useful discovery, or communicated some new information. By this means he was furnished with materials for his *Magia Naturalis*, the first edition of which was published, as he himself assures us, when he was scarcely fifteen years old, that is, about the year 1560.

The assemblies which were held at the house of the Neapolitan philosopher, excited the jealousy of the church of Rome, by whom they were prohibited.

On the first publication of the *Magia Naturalis*, it was translated into Italian, French, Spanish, and Arabic, and went through many editions in different countries. In this wonderful collection of all the curiosities in nature and art, which were known in that time, we find an accurate description of the camera obscura, and various other contrivances of great ingenuity.

Baptista Porta travelled through Italy, from which he went into France and Spain, visiting all the public libraries and learned men, and collecting all the information which he could obtain. When he was at Rome he was admitted into the Academy de Lyncæi; and he became acquainted with the celebrated Francis Paoli, from whom he obtained much curious information. He died at Naples in 1615.

Beside the *Magia Naturalis*, of which a second edition appeared in 1590, much enlarged, he published a work, *De Humana Physiognomia*, to which he added a *Physiognomia Celestis*. He published also a work, *De Æris Transmutationibus*. His principal mathematical works were his *Elementa Curvilinea*, and his *De Refractione Optices*, an account of which, and of his other optical labours, will be found in our article OPTICS, Vol. XV. p. 467.

Port-Glasgow.

PORT-GLASGOW, the name of a parish and town of Scotland, in Renfrewshire, and so called from being the port to the city of Glasgow. The citizens of Glasgow, feeling the want of a sufficient depth of water at the Bromielaw, resolved to have a port nearer the mouth of the Clyde. They first proposed to make an extensive harbour at Dumbarton, but being opposed by the magistrates of that burgh, they purchased, in 1662, thirteen acres of ground from Sir Robert Maxwell, near the village of Newark, about 19 miles below Glasgow, and having laid out the ground for a town, they built harbours, and erected the first dry or graving dock in Scotland. In 1714, Port-Glasgow was disjoined from the parish of Kilmalcolm, and erected into a separate parish; and, on the 22d February, 1718, it was agreed that a church should be built at Port-Glasgow, one half of the expence to be defrayed by the city of Glasgow, and the other by the feuars of Port-Glasgow.

In 1775, with the consent of the city of Glasgow, the town was erected into a burgh of barony, which is governed by two bailies and a council of eleven feuars, who possess at least £10 of annual income from heritable property. The city of Glasgow appoints the principal bailie and the town clerk.

The harbours of Port-Glasgow are capable of receiving the largest vessels without discharging any part of their cargo. There are extensive warehouses on the quay belonging to the Glasgow merchants. The ruins of the ancient castle of Newark, belonging to Lord Belhaven, are situated a little to the east of the town, on the banks of the river. It was once strongly fortified, and was built in 1599. The arms of the Maxwell family are placed over the main entrance.

In the bed of the river, opposite to this castle, several pieces of wreck have at different times been discovered, which are said to have been sunk in 1588, to prevent the Spanish armada from attempting the castle of Dumbarton.

The following Tables will show the state of the trade of Port-Glasgow, in the years ending 5th January 1815, and 5th January 1824.

Number of Ships and Vessels belonging to Port-Glasgow, with their Tonnage and Number of Men, that have loaded to and from this Port, in the under-mentioned periods.

		FOREIGN TRADE.			COASTING TRADE.			FISHING VESSELS.		
		Ships.	*Tons.*	*Men.*	*Ships.*	*Tons.*	*Men.*	*Ships.*	*Tons.*	*Men.*
1781	Port-Glasgow	70	6266	1274	16	664	72	25	1224	245
1782	. .	87	7295	960	28	1055	108	18	755	159
1783	. .	72	5956	699	31	1628	176	16	705	159
1784	. .	66	6180	654	24	1304	132	33	1482	287
1785	. .	117	8562	855	37	1786	217	14	669	165

N.B. Vessels to and from Ireland are included in the columns of foreign trade, and all Dumbarton vessels are included with those from Port-Glasgow.

An Account of the Number of Ships, with their Tonnage and Men, that have reported inwards at Port-Glasgow, during the Year ending 5th January 1815, also an Account of the Staple Articles.

Ships.			Cocoa.			Coffee.			Sugar.			Molasses.			Pimento.			Brandy	Rum.	Wine	Tobac.	Cot. Wool	Import Duties.		
No.	*Tons.*	*Men.*	*cwt.*	*qr.*	*lb.*	*cwt.*	*qr.*	*lb.*	*cwt.*	*qr.*	*lb.*	*cwt.*	*qr.*	*lb.*	*cwt.*	*qr.*	*lb.*	*gallons.*	*gallons.*	*galls.*	*lbs.*	*lbs.*	£	*s.*	*d.*
116	22,991	1416	847	2	26	36,502	2	21	230,327	1	12	27,121	2	19	398	3	22	15,321	470,147	5348	91,463	1,874,448	241,395	10	6½

Port-Glasgow, Port-Patrick.

An Account of the Number of Ships, with their Tonnage and Men, that have reported outwards at Port-Glasgow, during the Year ending 5th January 1815, also an Account of the Value of British Goods exported from thence.

Where Exported.	*Ships.*			*Value of Brit. Exports.*		
	No.	*Tonnage.*	*Men.*	£	*s.*	*d.*
America . .	28	6216	408	201,312	6	1
West Indies .	52	14,854	1043	534,534	18	1
Europe . .	153	12,783	807	236,008	11	5

In the year 1791, there were 125 vessels, bearing 12,760 tons, belonging to the town. In 1790, the number of vessels to and from the port, was 450, measuring 46,560 tons.

The following is the number of ships, with their tonnage, and number of men, that entered *inwards* and *outwards* at Port-Glasgow, in the year ending 5th January 1824.

	Ships.	*Tonnage.*	*Men.*
Inwards	161	28,064	1,467
Outwards	264	29,874	1,678
Total	425	57,938	3,145

The following articles were imported at Port-Glasgow, in the year ending 5th January 1824.

	Lib.				*Gallons.*
Coffee . .	145,144			Rum . .	47,471
				Wine .	4,336
	Cwt.	*gr.*	*lb.*		*Lib.*
Sugar .	160,753	0	14	Tobacco .	305,307
Molasses	17,210	2	6	Cotton Wool	893,052

The amount of duties of customs received at Port-Glasgow, in the year ending 5th January 1824, was £176,344, 0s. 11d.

Port-Glasgow is a port of the custom-house, but it has been recently proposed to deprive it of this privilege.

The population of Port-Glasgow is about 5500. See Cleland's *Annals of Glasgow*, 1816, vol. i. p. 18; and vol. ii. p. 389, 391.

PORT-PATRICK, a small maritime burgh, is situated on the west coast of Wigtonshire, nearly opposite to Donaghadee. It received its name, like many places in Scotland, from St. Patrick, the tutelary saint of Ireland. An attempt was made, in the sixteenth century, to supersede this ancient appellation. Hugh Montgomery, Viscount Airds in Ireland (whose descendants were afterwards raised to the title of Earl Mount-Alexander, which became extinct in 1758) having become possessed of this place, and of extensive lands in the neighbourhood, erected it into a burgh of barony, and conferred on it the name of Port-Montgomery, in honour of his own family. The original name was held in too high veneration to be easily laid aside. And when, a few years before the Restoration, this noble family disposed of the burgh and all their Scottish property, to the Rev. John Blair, minister of Port-Patrick (the ancestors of the Blairs of Dunskey) the ancient title was immediately resumed, and is still retained, and that of Port-Montgomery now entirely forgotten.

Port-Patrick enjoys a south-western exposure, and is bounded in every other direction by hills, which suddenly rise in a romantic semi-circular form to a height varying from one hundred to three hundred feet. It seems as if placed in an excavation dug out of the mountains by which it is surrounded, and which appear (chiefly when viewed from the channel) to approach the sea so nearly, that there could be no room for a single house, much less a thriving and extensive village. The only outlet is a small valley, about the centre of the semi-circle, through which a small stream flows, and falls into the sea on the north side of the village. The burgh is very little elevated above the level of the sea. The principal street is in the form of a crescent, running parallel with the bay, and there are three smaller streets connected with it, stretching at right angles towards the mountains. The houses are in general well built, comfortable, and covered with slate. The parish church, (built in 1628,) and the manse, are situated in the burgh. With the exception of the ground on which the custom-house stands, the feus are the property of Mr. Blair of Dunskey.

It is a place of extreme antiquity, but it was of no note till it formed the great thoroughfare between Ireland and Scotland. In the beginning of last century, the number of inhabitants did not exceed 100; but in 1790, they had amounted to fully 500; and including the workmen now employed at the improvements in the harbour, they extend to nearly 1000. The history of its harbour and of its official communication with Ireland, can be mentioned with considerable accuracy. It was not till 1662 that a mail was established between the two kingdoms; a measure accomplished by the Earl of Newburgh;—and in the same year, the privy council gave L.200 Sterling to Robert Main, post-master-general for Scotland, to build a packet-boat for conveying the mail between Port-Patrick and Donaghadee. At what intervals it was to ply between these places, cannot now be ascertained; but as by an act of the Scottish Parliament in 1695, it was fixed to go weekly, it is evident it must previously have crossed seldomer, or at least more irregularly than then determined. Nor did it go regularly for some time after this period. Packet-boats indeed continued to be established, and the intervals for passing fixed by law; yet as there was no quay or safe-landing place on either side, and as the wages of the sailors were the same whether they crossed regularly or not, they availed themselves of the least excuse for remaining in harbour; and thus defeated the object for which they were employed. Government therefore saw that a change was necessary. The established packets were accordingly abolished, and a rule fixed, that whatever vessel should sail first, after the mail arrived, should have the carrying of it, with a certain allowance for the service. This, operating as a premium, had for a long time a good effect. But the communication between the two kingdoms increasing, the allowance made by government became of comparatively little importance; and a boat would not sail unless she had a freight or cargo in addition to the mail. The original plan of official packets was again resorted to, but, upon more strict, vigilant, and liberal principles. They are four in number, and the allowance made them by government is L.800. In addition to the conveying of the mail, they are fitted up for the accommodation of passengers; the distance is twenty-one miles; they cross daily; no accident has hitherto taken place; and so regular is the communication, that, except in the stormy days of winter, an Irish mail is very seldom due.

But the great perfection to which the transference of the mail is brought, was owing not less to the improvements made on the harbour, than to any other circumstance. Port-Patrick possesses few natural advantages as a harbour, and seems indeed at one time to have been little used in that capacity, Portree, or the *King's Harbour*, about five furlongs south of Port Patrick, being regarded, as is probable from the name, as the chief port of that district.* The harbour was originally a mere inlet between two ridges of rocks, which run far into the sea, and which could not be entered without danger; and vessels, when they had entered them, had to be run a-ground to avoid being dashed in pieces by the tremendous swell which always, but particularly with a westerly breeze, obtains there. Whenever a vessel approached the harbour in ancient times, the whole inhabitants assembled to draw her up to the beach, there being no quay or elbow to afford shelter from the waves. None of course but flat-bottomed boats could enter the place; indeed the original government packets were of this description; and, in the memory of several persons still alive, two of these flats belonged to the harbour, and were in active operation. But circumstances have long been changed. A quay and a reflecting lighthouse were built about sixty years ago; and instead of a few flat-bottomed boats, Port-Patrick, exclusive of the packets, can now boast of nearly a dozen vessels, employed in the coasting trade, or in trading with Ireland. A custom-house has been established; and as the place forms the great thoroughfare to Ireland, there is about it as much bustle, liveliness, and importance, as would do honour to a much larger and a more celebrated town.

But great as have been the improvements already made, greater and more extensive ones have lately been begun. Though an excellent pier has been erected, and the port otherwise much improved, yet the two ledges of rocks, which run into the sea, and render the mouth of the harbour so difficult and dangerous, have hitherto been allowed to remain. These rocks, however, are now about to be removed; and two piers, nearly in the same line as the rocks, are to be built, calculated to inclose seven acres of water; so that Port-Patrick will form one of the most accessible, extensive, and safe harbours, on our Scottish coast. Commissioners have been appointed by parliament for carrying the work into effect, according to a plan of the late Mr. Rennie. The son of this respectable gentleman is the engineer of the work; but Mr. Henry is appointed as his substitute, and resides. The resident commissioners are Mr. Blair, Collector Hannay, and the Rev. Dr. M'Kenzie. The work was begun in March 1821; and though upwards of a hundred men are employed, a small part of it only has yet been accomplished. It is carried on by means of the diving bell. The expence is calculated at about L.150,000, which is defrayed in the mean time by annual grants from government, but will soon be reimbursed by an additional postage (amounting to about L.3000 per annum) which has been laid on letters to and from Ireland.

Nor are these all the improvements connected with this harbour that are to take place. A steam-boat is to be employed to carry the mail between the two kingdoms; and a new line of road is to be made between Stranraer and Ayr; a circumstance that will prove vastly beneficial, as it will render the mail between these places, which has hitherto been carried on horseback, to be conveyed by coaches, and as it will be remarkably commodious and useful to travellers. Improvements similar to those at Port-Patrick are going on at Donaghadee, the harbour of which has hitherto been dangerous and insufficient.

The inhabitants of Port-Patrick, with few exceptions, are mariners, or are connected with the harbour, and attend to the accommodation of passengers, or are innkeepers; of whom the latter class is comparatively numerous, almost every house being used as an inn. They are in general sober and industrious. Their chief commercial connexion is with Ireland. Irish linen is imported in great quantities. But the chief articles imported from that country are black cattle and horses. The number of the former imported for five years previously to 1791, averaged 11,000 per annum; that of horses 2000. Fishing has never flourished much, though some years herrings have been caught in great abundance. The atmosphere is pure, and the climate mild, often sultry indeed, as the town is defended from the cold winds by the mountain chain by which it is environed. The west wind is most prevalent, and is often accompanied with rain, which is more common here than in the interior of the country.—The greater part of the materials of which this article is composed have not before been given to the public. The best books on the subject are an account of Port-Patrick by the Rev. Dr. M'Kenzie, in the 1st vol. of the *Statistical Account of Scotland;* Chalmers's *Caledonia*, vol. iii. § Wigtonshire; Forsyth's *Beauties of Scotland*; Symson's *Account of Galloway*. (T. M.)

PORTER BREWERY and BREWING. See BREWING, Vol. IV. p. 459.

PORTEUS, BEILBY, late Bishop of London, and an eminent divine, was born at York in 1731, of American parents. From Rippon, where he received the rudiments of his classical education, he went to Christ's College, Cambridge, where he was admitted to the degree of B.A. in 1751, and he carried off the second of two honorary medals given as a reward for eminent attainments in classical literature. In the same year he was elected a Fellow of the College, and took up his residence at Cambridge. In 1755 he took his degree of M.A. and in 1757 was ordained Deacon, and soon after appointed one of the preachers of Whitehall chapel.

In the year 1759 Mr. Porteus obtained the Seatonian prize for the best poetical *Essay on Death*, which was published, and gave high earnest of his future celebrity. The first of his prose publications was a sermon, preached before the University of Cambridge in 1761, entitled, "*The Character of David, King of Israel, impartially considered.*" Dr. Secker, archbishop of Canterbury, was induced, by the perusal of this sermon, to appoint him one of his domestic chaplains; and he soon after presented him to two rectories in Kent, and one in Middlesex, and also to a prebend's stall in the cathedral church of Peterborough.

In 1765 he married Miss Hodgson, a lady of small

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* Portree was originally the name of the barony now called Dunskey; and Port-Patrick was a port belonging to it. The proprietors of it, before it fell into the hands of Hugh Montgomery, were the Adairs of Kilhilt. The family of Blair preferred the name of Dunskey to its former appellation from a romantic and ancient castle which belongs to it, and which stands on a precipitous peninsular rock, about a quarter of a mile south of Port-Patrick. At what time the present castle, which has long been in ruins, was built, cannot be known; but it is recorded that there was a castle on the same site so early as the reign of Eugenius V. who lived in the seventh century.

Porteus, Bishop ‖ Porto Rico.

fortune, from Ashbourne, in Derbyshire. In 1767 he was made rector of Lambeth, and in the same year he obtained the degree of D.D.

Upon the death of the Archbishop, in 1767, Dr. Porteus, in conjunction with Dr. Stinton, edited Dr. Secker's works, in seven volumes, to which was prefixed a life of the author from the pen of Dr. Porteus.

The Queen having become acquainted with the character and talents of Dr. Porteus, recommended him to the King as his chaplain; and he soon after became Master of the Hospital of St. Cross, near Winchester, Dean of the Chapel Royal, and Provincial Dean of Canterbury.

He was soon after raised to the see of Chester; and in the year 1783, he published a volume of sermons on various subjects, which underwent several editions.

Upon the death of Dr. Lowth in 1787, Dr. Porteus was translated to the bishoprick of London; and, in 1790, he published the charge which he delivered on the first visitation of his diocese. A second volume of his sermons appeared in 1777, and, during the Lent of 1778, he began a series of Discourses on the Truth of the Gospel History, which he delivered every Friday to crowded audiences at St. James's Church, Westminster. In 1802, these discourses were published, under the title of "*Lectures on St. Matthew's Gospel,*" in 2 vols. 8vo. The last work which Bishop Porteus published, was entitled "*The Beneficial Effects of Christianity on the Temporal Concerns of Mankind, proved from History and Facts,*" which appeared in 1806. Having been long in a weak state of health, his bodily frame began to experience a rapid decline of strength, and, on the 14th May 1808, he expired in the seventy-eighth year of his age.

The benevolence and liberality of Dr. Porteus were no less distinguished than his character and conduct as a prelate. During his life he transferred £7000 in the 3 per cents to the archdeacons of the diocese of London, as a permanent fund for relieving the wants of the poorer clergy of his diocese. He likewise bequeathed three gold medals to Christ's Church, to be contended for annually by the students of the college; one, valued at fifteen guineas, for the best Latin dissertation on any of the chief evidences of Christianity; another of equal value for the best English composition on some moral precept in the Gospel; and one of ten guineas to the best reader in, and the most constant attendant at chapel. He likewise left a library for the use of his successors in the see of London, and a liberal sum for erecting a building to receive it, at the Episcopal Palace of Fulham. At Hydehill, near Sundridge, in Kent, where he had a country house, he built a chapel, beneath which he directed his remains to be deposited; and he endowed this chapel with an annual income of £250 per annum. See Hodgson's *Life of Porteus.*

PORTICI, the name of a small town of Italy, near Naples, situated at the sea-shore, at the foot of Mount Vesuvius. The principal ornament of the town is a royal palace. Beneath the town and palace, lies buried, at the depth of 70 feet, the city of *Herculaneum*, which we have already described in Vol. X. p. 739. Population of the town 5200. See Eustace's *Travels*, vol. i. p. 582.

PORTLAND ISLE. See DORSETSHIRE, Vol. VIII. p. 54.

PORTO. See OPORTO, Vol. xv. p. 459.

PORTO-RICO, an island in the West Indies, about 60 miles east of Hispaniola. Its length from east to west is about 140 miles, and its breadth from north to south about 36. It is highly fertile; is diversified with woods, hills, and valleys; is watered with a variety of streams, and has rich meadows, which feed great quantities of cattle. The woods abound with parrots, wild pigeons, and other fowls, and the breed of dogs brought over by the Spaniards is said still to exist wild in the woods, and to subsist upon land-crabs that burrow in the ground.

The chief trade of the island consists in cotton, sugar, ginger, tobacco, hides, cassia, mastic, silk, oranges, lemons, &c.

Porto-Rico was discovered by Columbus in 1493, but it was not till 1509 that it attracted the notice of the Spaniards. A considerable time ago there were 1500 Spaniards in the island, and 3000 negroes.

St. Juan de Porto-Rico, the capital of the island, was founded in 1514. It is populous and well built, and has a good harbour, defended by a citadel and castle. West Long. of the town 66° 13′ 15″, and North Lat. 18° 29′ 10″.

PORTSMOUTH, a sea-port town of England, in Hampshire, is situated on the coast of the English Channel, and on the west side of the isle of Portsea. It comprehends the old town of Portsmouth, and the town of Portsea, which is situated within the borough, and subject to the jurisdiction of the magistracy.

The town of Portsmouth is the seat of the civil and military establishments, and the residence of the port-admiral. Its streets are more spacious than those of Portsea, and the houses and buildings are generally of a superior character. The town of Portsea, however, surpasses it in size and population, and contains within its limits the dock-yard and gun-wharf, to the first of which Portsmouth owes much of its real importance.

Within the last fifty years, this town has undergone great improvements, the paving of Portsmouth having been finished in 1775, and that of Portsea in 1792. The church of Portsmouth, which is a spacious structure, has been erected at different periods. It has a tower 120 feet high, which forms a useful sea-mark. Behind the altar there is a large and elaborate cenotaph to the memory of the celebrated Duke of Buckingham. The parish church of Portsea is two miles distant from the town, at the hamlet of Kingston; but there are several handsome chapels in the town, the chief of which are dedicated to St. James and St. John, and the last of which is particularly elegant within. Besides these churches, there are various meeting-houses for dissenters.

The town-house where the borough courts are held, is a large building, situated near the middle of the high street, and was repaired and enlarged in 1796. At a short distance from it stands the white house or town prison, in which the prisoners are separated into classes, and which is under excellent regulations. The government house, situated at the upper end of the grand parade, was part of an old hospital, but is now an excellent residence for the governor of Portsmouth. The residences of the lieutenant-governor and of the port-admiral, are both elegant and commodious buildings; particularly the latter, which is situated in the high street.

The dock-yard of Portsmouth, which is very extensive, contains immense store-houses, handsome residences for the principal officers, an elegant house for the commissioner, an academy for naval instruction, a chapel, and extensive workshops, mast houses and

Portsmouth.

other buildings. The dock-yard is entered by a lofty gateway. The Royal Naval Academy consists of a centre and two wings; in one of which is a fine model of the Victory of 110 guns, which was lost in 1779. There is an excellent observatory in the academy. The commissioner's house is a spacious building, consisting of a centre and two wings, with an elegant portico. The next buildings are a range of store-houses, a neat modern chapel, in the cupola of which is hung the bell of the Royal George, and the new guard-house, with a handsome portico. At the anchor wharf, an extensive range of anchors, of all dimensions, are kept, some of which weigh from forty to ninety tons each. The rope-house is a spacious building of great length, and three stories high. It is 1094 feet long, and 54 broad. The cables are twisted in the lower storey by the aid of machinery, and the other processes are carried on in the upper ones. Another object of great interest is the great smithy, where the spectator is stunned by the noise and clanking of hammers. The range of store-houses on the north-east is about 600 feet long, and the sail loft, and rigging-house are also huge buildings, both 400 feet long. A length of 800 feet is occupied by the two hemp-houses and the two sea-storehouses, and the tarring-houses, and other appendages of the rope-houses are on a similar scale. Near the smithy is an iron-mill, a copper-mill, and a refinery of copper, where all the old copper of ships' bottoms are again melted and rolled. At the head of the north dock stands the wood-mill, where the celebrated block machinery is placed, and where every article of turnery, rabitting, &c. is made. Seasoning sheds, saw-pits, timber births, and the washing-house, coal-house, and boat-storehouse, occupy the western extremity of the yard. The jetty heads, the docks, and the rigging-houses, are all objects of great interest. During peace, about 2000 men are commonly employed in this dock, and in war sometimes 5000 have been employed.

The gun wharf embraces several ranges of buildings for holding naval and military artillery, &c. On the wharf is the grand depot for guns, carronades, and mortars, with shot and shells of all sizes, ranged in immense pyramidal piles. The small armoury is a recent building, capable of holding arms for 25,000 men. The victualling office consists of several extensive ranges of buildings, including an excellent house for the agent, victualler, and a storehouse, extending the whole length of St. Thomas Street, and containing the spirits and liquors for the supply of the navy. The beef and pork are prepared and salted, and the biscuits baked in the other buildings. The wheat for the biscuit is ground at the King's Mill, on the Portsea side, which was built on piles, and cost L.7000. It is driven by a stream of salt water, admitted from the harbour through a large sluice, which is closed at high water. On the ebbing of the tide the stream returns to the harbour after performing its work in the mill.

Portsmouth harbour surpasses every other in the United Kingdom by its depth, its capaciousness, and its security. The largest first rates may ride here at the lowest ebbs without touching the ground; and it has been considered as capable of receiving the whole British navy. When ships are driven from their anchors at Spithead, they find perfect shelter within Portsmouth harbour. This harbour is very narrow at its entrance, which does not exceed the breadth of the Thames at Westminster, but it rapidly expands, and throws out several branches to Fareham, Porchester, and Portbridge. The bottom every where affords good anchorage, and it is so completely free of bars and impediments, that a first rate can set sail at any time of the tide, and quit the harbour in the deep water beneath South Sea Castle. Portsmouth harbour is likewise secure from any attack by sea, by means of the various forts and batteries which defend the approach, and are nearly level with the water's edge.

The fortifications of the town were commenced by Edward IV.; and since that time they have been greatly increased, and are now deemed impregnable. Charles II. improved and enlarged them by a kind of star-fort round South Sea Castle; but as this was partly blown up by accident in 1759, L.6937 was granted by the parliament for improving the works. William III. also made additions to the defence of the town, and since 1770 many others have been completed at a vast expence. The newest fortifications are those on the Portsea side, and the works which are faced with stone, are so elevated as to command the surrounding country. The ditches are wide and deep; and strong and capacious outworks strengthen the whole line. An extensive ravelin at the head of the creek between Portsea and Portsmouth, connects these works with those of the latter town, the communication between the towns being preserved by a long bridge, which leads to St. Thomas's gate. The fortifications on the Portsmouth side, which extend from the town to South Sea Castle, form a noble semi-circular terrace, above a mile in length, which is planted with elms, and forms a favourite promenade. From the Platform, which is the principal resort of company, there is a fine sea view of unrivalled beauty.

Among the charitable establishments of this town, is a free grammar school, founded by Dr. Smith, who gave the patronage of it to the dean and chapter of Christ's Church. There are several other schools here, particularly one under the patronage of a Friendly Society, kept in the Society Hall. There is also here an alms-house for eight poor widows. The poor are here employed chiefly in picking oakum. The poors-house of Portsmouth is an old building, in a confined and dissolute part of the town. That of Portsea occupies a more open spot, about a mile distant, and has within its walls a garden and a large area.

The custom-house is situated in Broad Street, which forms part of the western suburb. It is a large and commodious building, with an extensive establishment. The merchant ships lie in a large bay, between the gun wharf and the Point, having the advantage of an excellent quay, with all its appendages. This communicates with Portsmouth by a large gate, called the quay-gate. At the point, and close to the mouth of the harbour, is a bathing-house, which is both spacious and commodious. Several extensive breweries have been established at Portsmouth, and a bank has been erected on the Parade. There is a theatre in the town, which is well attended. Two newspapers are regularly published in the town. A new prison has been recently built in Penryn Street at an expence of L.20,000.

The towns of Portsmouth and Portsea are governed by a mayor, a recorder, twelve aldermen, an unlimited number of burgesses, and some inferior officers.

Portsmouth sends two members to parliament; the right of election being vested in the mayor, aldermen, and burgesses, who now amount to 110.

In the neck of Spithead, at the distance of about a mile from the entrance of Portsmouth harbour, is a buoy, which marks the spot where the Royal George, of 100 guns, was sunk by accident in 1782. When

Portsmouth. lying on her side to repair her keel, a sudden squall threw her broadside on the water, and the lower deck ports not having been lashed down, she filled with water and sunk in about three minutes. Admiral Kempenfelt and above 400 of her crew, besides 200 women, perished in her. Her top-masts are yet visible above water.

The following is the population of the burgh of Portsmouth and the town of Portsea, according to the census of 1821.

Inhabited houses,	8,627
Families,	10,460
Houses building,	17
Houses uninhabited,	628
Families employed in agriculture,	692
Ditto in trade,	4,445
Males,	20,425
Females,	25,223
Total population,	45,668
Total population in 1811,	40,567
Increase since 1811,	5,081

Position of Portsmouth Academy, West. Long. 1° 6′ 1″. North Lat. 50° 48′ 2″. For farther information respecting Portsmouth, see the *Beauties of England and Wales*, vol. vi. p. 314—332. M. Dupin's *Mémoires sur la Marine et les Ponts et Chaussées de France et Angleterre*. Paris, 1818, p. 36.; and his *Force Militaire de Grande Bretagne*, tom. ii. p. 425.

PORTSOY is a considerable sea-port town of Scotland, in the county of Banff, and parish of Fordyce. It stands on a point of land projecting into the Moray Firth, which forms a secure harbour for vessels of considerable burthen. There is here a species of serpentine, called Portsoy marble, which is manufactured into tea-cups, vases, sleeve buttons, and other small ornaments. The quarry of it is very extensive, and stretches out about four miles in length. Another mineral found here has excited great interest in consequence of having been described and drawn by the late Dr. Hutton in the *Edinburgh Transactions*, vol. i. p. 255, and Plate ii. It is a sort of flesh-coloured granite, and occurs about four or five miles west of Portsoy, on the road to Huntly. It is connected with the common granite of the country. The singularity of this kind of granite consists in the uniformity of the ground of feldspar, and the regular shape of the quartz mixture. The transverse sections of these longitudinal prisms of silex, exhibits not only separately the forms of certain typographic characters, but collectively give the regular lineal appearance of types set in writing.

Portsoy, besides sending out a number of vessels to the fishery, carries on a considerable manufacture of thread for the London and Nottingham markets. The population of the town is about 1000. West Long. 2° 36′ and North Lat. 57° 38′.

PORTUGAL.

Portugal. Situation. PORTUGAL, the most westerly kingdom of Europe, is bounded on the west and south by the Atlantic Ocean, and on the east and north by Spain. It is situated beween 36° 56′ and 42° 7′ of north latitude, and 7° 34′ and 9° 30′ of west longitude. Its form is oblong, extending in length from north to south 360 British miles, and in medial breadth from east to west 120, —its superficial extent being estimated at about 40,000 square miles.

Name. Respecting the name of Portugal there have been various conjectures. Some have asserted that a colony of Gauls, having landed at the place now denominated Oporto, called it *Portus Gallorum;* and that at length the name was applied to the whole country, but softened into Portugal. The most probable, and the generally received opinion, however, is, that on an eminence overlooking the site of the present Oporto, there was, during the time of the Romans, a town or fort named Calle, and that the harbour of this place (the mouth of the river Douro) being of unrivalled excellence, it was, by way of distinction, termed *Portus Callus*, or *Porto Calle;* a name which, as the country was gradually recovered from the Moors, was extended to the whole kingdom. The ancient appellation of this country was *Lusitania;* but the boundaries of the two did not exactly correspond, Lusitania excluding the two southern provinces of Portugal, and comprehending some portions of the north-western districts of Spain. The term Portugal does not occur in any writings earlier than the middle of the eleventh century.

Population. Portugal is divided into six provinces: Entre Douro e Minho, and Tras os Montes towards the north; Beira and Estremadura in the centre; Alentejo and Algarve towards the south. The population of this kingdom was long a subject of conjecture and uncertainty; but a census of the kingdom having been instituted in 1802, the truth has now been exactly ascertained. The two northern provinces were found to contain 907,965 and 318,605 souls respectively; the two central, 1,121,595 and 826,680; the two in the south, 380,480 and 127,615—making altogether a total of 3,683,000. The number of parishes was ascertained to amount to no fewer than 4262; the number of families to 760,152; averaging, it is evident, 178 families to each parish, and nearly five individuals to each family.

The climate of Portugal is various in the different parts of the kingdom. In the south it is extremely mild and pleasant, and would indeed be scorching, were it not moderated by the Atlantic breezes. It is considerably more temperate in the centre; while in the north it is comparatively cold, is subject to rains to a degree unknown in any other part of the kingdom, and is altogether characteristic of a country situated several degrees farther distant from a tropical region. The rugged mountain tracts of Tras os Montes, together with its northern situation, may probably account for this diversity of climate. In every quarter of the kingdom, indeed, the mountain ridges are remarkable for comparative intensity of cold; while, in the valleys, which are extensive and numerous, the air is infinitely milder and more genial; not so much so, however, as in the parallel situations of Spain, as these latter enjoy not the cooling advantages of the sea-coast, by which the former is every where distinguished. In Portugal frost is never very intense, and, in most cases, the frost which is formed during the night the heat of the returning sun immediately thaws and removes. Snow also is extremely rare, except on the summits of the highest mountains; in so much, to use the words of an intelligent traveller, that, in the year 1784, some happening to fall, "the common people were so alarmed that they ran into the churches, and thought the end of the world was coming." The fall of rain, particularly in winter, is very considerable, and is often so rapid, (though of short continuance,) that rivers, which had been nearly dried up, not uncommonly in a few hours overflow their banks, and rush in torrents in all directions. At Lisbon, which is probably the mildest and most salubrious spot in the kingdom, and which is much resorted to by persons from Great Britain threatened with consumption and pulmonary complaints, the days of fair weather are computed to amount to 200 in the year; while those of settled rain seldom are known to exceed 80. The medial heat is about 60°.

The physical appearance of Portugal is extremely diversified and interesting. Elegant vineyards, groves of orange and lemon trees, verdant vales, and meadows, rivers of every degree of magnitude, dashing down craggy steeps, or meandering in valleys, together with extensive mountain ridges, wild and majestic,—are the features for which this country is remarkable. Numerous valleys of the most picturesque description, are formed by the mountain chains, with which Portugal so much abounds; but the most rich and celebrated meadow land lies in the north-west, between the Douro and the Minho; and there are, besides, two extremely extensive plains, one to the south of the Tagus, near Santarem, and the other at the mouth of the Vouga in the north. Notwithstanding these valleys and plains, however, Portugal may in some respects be denominated a mountainous country. Several of the great mountain chains of Spain penetrate into it, and intersecting it from east to west, terminate in large promontories in the Atlantic. Of these the most remarkable are the Serra de Estrella, which traverses the province of Beira, and the Serra de Monchique in Algarve, of which Cape St. Vincent forms the extremity. There are also various clusters of mountains, unconnected with any of the Spanish chains,—such as those in the north-east in Tras os Montes, those which separate Alentejo from Algarve, and Cintra situated about five leagues south-west of Lisbon, and known to navigators as the Cape in which it terminates, and denominated Cabo de Rocca, the most westerly part, not only of Portugal, but of Europe. These mountains are generally rocky, chiefly granitic,—and are barren, if we except Monte Junto, the ancient Sagrus in Estremadura, which is clothed with verdure, and affords a rich pasturage. The highest mountains in Portugal do not exceed six thousand feet, while in some cases the same chain in Spain may be estimated at eight thousand. For a more minute description of the mountains of Portugal, we refer the reader to Link's *Travels in Spain*, (Lond. 1801, one vol. 8vo.) decidedly the best book on this subject yet published.

Few countries can boast of a greater number of rivers than Portugal. Castro enumerates about two hundred, great and small, of which some are very large, beautiful, and majestic. For the largest, as is the case with the mountains as mentioned above, this country is indebted to Spain,—the Tagus, the Douro, the Minho, and the Guadiana, having their origin in that kingdom. The Tagus rises in the mountains of Molina, at the extremity of Castile, next to Arragon, whence flowing in a direction nearly west, it falls into the Atlantic, after a course of 450 miles, of which 150 are in Portugal, and the remainder in Spain. From the numerous tributary streams by which it is augmented, its waters become very copious ere it approaches Lisbon, where it meets a branch of the Atlantic, and forms one of the noblest harbours in the world for extent, depth, and shelter. This river, like the Nile, annually overflows its banks, and inundates the adjacent champagne country; a circumstance which renders the soil so exceedingly fertile, that, to use the words of an excellent writer, "the farmers have often reaped an abundant crop of excellent wheat within the space of fifty days from the time of sowing the grain. And immediately after Indian corn has been sown in the same ground, and become ripe in nearly the same space of time." (Murphy's *State of Society in Portugal*, 4to. p. 15.) These inundations, however, though generally favourable, are not unfrequently attended with very injurious consequences; for when the overflow happens to be unusually great, the water remains so long that the crops are either entirely destroyed, or greatly injured by mildew. The Tagus, however, whatever be its other characteristics, is navigable for no considerable distance farther than Lisbon. This inconvenience, so unfavourable to the internal communication of the kingdom, the Portuguese have as yet wanted enterprise to attempt to remove, though, according to Mr. Murphy, this river might, without much ingenuity or much expence, be made navigable so far east as Alcantara, on the frontiers of Spain. It is not improbable indeed that not only this much may in time be effected, but that a communication may be thus opened between the capitals of Spain and Portugal; an object worthy the attention of the respective governments of the two countries.—The Douro, another important river of Portugal, also has its origin in Spain; and after a course of 360 miles nearly due west, flows into the Atlantic, four miles below the city of Oporto. It is next to the Tagus in point of size and copiousness of waters, but, unlike that river, it is navigable above sixty miles from its mouth. It is often so rapid in its course, from sudden falls of rain, that for several days the communication between the inhabitants on the opposite banks is either very dangerous or entirely interrupted, as there are no bridges, and boats cannot always venture to cross it. Its course is generally rugged, and its channel in some places reduced to extremely narrow limits by ridges of lofty mountains, yet few rivers can exhibit such sweet and inviting scenes as those connected with the Douro in its passage through the rich and beautiful province of Entre Douro e Minho.—The Minho, next in importance to the Tagus and the Douro, takes its origin in Gallicia, and flowing in a westerly direction, and forming the northern boundary of Portugal, falls into the Atlantic. Its course extends to about a hundred miles.—The Guadiana, the only other very large river belonging to this kingdom, rises in New Castile, runs west till it enters Portugal, then assumes a southerly direction, and falls into the Atlantic, forming, for a considerable way, the south-eastern boundary of the kingdom.—The Lima is a small river that has its source in Gallicia, and flows through the province of Entre Douro e Minho into the Atlantic. Pliny absurdly relates of this stream, that, among its other properties, it possessed that by which those who crossed it no longer remembered the former occurrences of their lives; an opinion which has of course been daily disproved since the days of that writer. The most important native Portuguese rivers are the Mondego, the Vouga, and the Sadaon. The Sadaon, not otherwise remarkable, forms the celebrated harbour of St. Ubes or Setubal. But of these native streams, the largest is the Mondego, which has its origin in the Serra de Estrella, in the province of Beira, flows past the ancient city of Coimbra, to which it is navigable, and terminates in the Atlantic. It is so distinguished for gold-sand, that many who live on its banks gain a livelihood by collecting that precious article. The Tagus and the Douro also were formerly celebrated for the same quality, but it seems now to have forsaken them.

Internal communication.

Notwithstanding the great number and size of the rivers of Portugal, however, there is an uncommon deficiency of internal communication. Few of the rivers are navigable to any extent; there are no canals; the number of bridges is extremely small; and the roads are so exceedingly bad, that in several parts of the kingdom there is no conveyance for goods or travellers by wheel carriages. The extensive and numerous mountain chains tend also, in a great measure, to obstruct communication between the inhabitants of the different districts. The result of this is generally and severely felt. Farmers, for example, will not raise a greater quantity of commodities than can be consumed either on their own grounds or in the neighbouring villages, because if their productions exceed a certain limit, there is no possible way of getting them disposed of and consumed from want of internal communication. It was indeed found to be as cheap to import into Lisbon articles from Brazil, as to convey them to that capital by land from the remote eastern boundaries of the kingdom. In this department, however, some improvements have of late taken place, and promise to be progressive. The merchants of Oporto have constructed a road to Lamego for the conveyance of their wines, and are still extending it. A good road has been formed to Mafra, and the government has been occupied in forming one to Coimbra. Much yet remains to be done; and the time, we hope, is not far distant when Portugal will no longer be regarded, in point of internal intercourse and commerce, as decidedly the worst country in Europe.

Mineral waters.

Portugal, while it abounds with so many copious rivers, possesses nothing that can with propriety be denominated a lake. Murphy mentions three merely; and even these Pinkerton regards as not larger, or more worthy of notice, than pools. This kingdom, however, though deficient in lakes, is distinguished by numerous baths and mineral waters. Of the former, the most celebrated are those called Caldas da Rainha, situated about forty-five miles from Lisbon. They were known to the Romans; and, since that time, they have been frequented, not by the Portuguese only, but by valetudinarians from every quarter of Europe. The baths of Chaves were also known to the Romans, and have long been considered the best in the kingdom for persons affected with nervous complaints. The number of mineral wells are incredibly great, and cannot in this place be specified. Near Estremos is a spring which becomes dry in winter, but pours forth a considerable stream during summer. The waters are of a petrifying nature, in so much, that the wheels of mills which they drive acquire, after a short time, an incrustation of stone. In the neighbourhood of Santarem, there is a spring of salt water, though the distance from the sea is six leagues. Within a short distance of Braga, is a spring, the waters of which, during the most intense heat of summer, are so excessively cold, that the hand cannot be endured in them for many minutes, and if a bottle of wine be immersed in them, it instantly becomes changed to vinegar. This singular result with regard to wine, is said to take place in various other springs throughout Portugal.

Mineralogy.

The mineralogy of Portugal was, in ancient times, much more sedulously cultivated, and more celebrated, than at present. In the two northern provinces, in particular, immense mines are to be seen, supposed to have been wrought by the Romans. The mouth of the largest, cut through the solid rock, is a mile and a half in circumference, and upwards of five hundred feet deep: at the bottom it measures 2400 by 1400. Many subterranean passages and chambers of great extent are connected with it, and altogether it seems to have been one of the most stupendous works of the kind of which Portugal can boast. The mines of this kingdom, long wrought with great ardour, were neglected so soon as De Gama had opened a way to the East by the Cape of Good Hope, and the Portuguese government had established a footing in Brazil, it having been found more profitable, and more consistent with the spirit of enterprise then prevalent, to import the mineral productions of these countries. Though thus neglected, however, the mineral kingdom of Portugal exhibits the most promising and rich indications, and may at no distant period become a source of immense revenue. Veins of gold have been observed in the Serra de Estrella and elsewhere, and, as a proof that this metal is common, the sands of various rivers are impregnated with it. A silver mine was wrought in the neighbourhood of Braganza, so lately as the 17th century. Tin, lead, and iron mines, have been discovered in various parts of the kingdom. Coal, however, is by no means abundant. Emery, marble, granite, and talc, every where abound. "Amianthus," to use the words of a writer on Portugal, "is discovered in such quantities, that it has been recommended to the artillery in the form of combustible paper." Portugal can also boast of antimony, manganese, bismuth, arsenic, quicksilver. Rubies, jacinths, beryls, have also been found. This kingdom, it is evident, from this enumeration, is hardly inferior to any country in Europe in regard to minerals of almost every description; and while it is allowed that for centuries back she has neglected to avail herself of the advantages in this department which she so liberally enjoys, it must not at the same time be denied, that a want of fuel, so deeply felt in Portugal, and a want of internal communication would, under any circumstances, prove an almost insurmountable obstacle to every exertion of industry and enterprise. The great disadvantages, indeed, under which this country labours, are, as has already been incidentally hinted, a deficiency in water (particularly in the southern provinces) and in fuel; and from the want of roads, canals, and bridges, an almost total impossibility of internal intercourse and commerce.

Soil, cultur, and productio

The soil of Portugal is generally light, except perhaps in some of the extensive valleys formed by the numerous mountain chains with which the country abounds: but no agricultural means have for centuries been used to improve it and promote its fertility. There is probably no quarter in Europe, enjoying equal natural advantages, and inhabited by an equally refined and intelligent population, that has been so long and so completely neglected. During the early ages of the Portuguese monarchy, however, agriculture was patronised and flourished, insomuch, that the nation produced corn in abundance, not only for the consumption of its inhabitants, but also for exportation. But this promising state of things was counteracted by the first expeditions to Africa, and by the discoveries and conquests made in Asia and America, as the ambition and interest of the Portuguese were thus directed from their own country to distant settlements. The import of the precious metals obtained in remote regions, and the incessant drain of their population, paralysed and suspended industry at home, and, by substituting artificial for real wealth, paved the way for that deteriorated domestic economy, which still obtains in Portugal. The delusive sources of wealth in which the Portuguese so long trusted, are now beginning to be seen in their true light: they now begin to appreciate the value of internal resources, and to see that it is impolitic to import from their African or Asiatic dominions commodities which their own country itself can produce, and by the exertion of a little industry can produce with less uncertainty, and probably at less expence, than they can be procured from distant colonies. Their ignorance of agriculture, however, is yet proverbial. They are still unacquainted with rotation in crops; and so unconscious are they of the difference between one kind of soil and another, that they extract the same crop indiscriminately from every species of land. The plough, awkwardly and clumsily made, moves almost on the surface; the ground is seldom harrowed; and the use of the hoe, and the nature of fallow, are nearly entirely unknown. Even thrashing, the most simple and obvious of all operations, is seldom practised; the same result being obtained by the antiquated and wasteful method of trampling the straw under the feet of oxen and horses. Portugal, as may easily be supposed from these statements, has not yet produced corn adequate to the consumption of its inhabitants, and the deficiency requires to be supplied by importation. The products of the soil, however, are extremely various; a circumstance resulting from the great difference of latitude (about five degrees,) and from the great variety of elevation by which the country is distinguished. The higher grounds produce wheat, barley, oats, flax, hemp; lands of an inferior altitude, and warmer temperature, grow vines and maize; while rice, and other articles, are raised in the low grounds. The cultivation of potatoes has been introduced on the more elevated parts of the country with such success, that they now form a considerable proportion of the sustenance of the inhabitants. The Portuguese are extremely indolent and lazy; and accordingly those productions that require little labour, such as chesnuts, almonds, oranges, lemons, citrons, are profusely raised. Olive trees are one of their chief products; and the oil obtained from them forms an important article of the table; and though not of a character or flavour that causes it to be used as an article of sustenance in foreign countries, it is exported to a great extent, being used by the woollen manufacturers of England, Holland, and Germany, in their respective operations. Improvements in husbandry, and in the general cultivation of the soil, have of late, as hinted above, been rapidly made; but the only province that has yet attained to much distinction in this way, (a distinction, indeed, which it has enjoyed more or less for centuries,) is that of Entre Douro e Minho. It possesses, indeed, some peculiar advantages; its supply of water is great, and its surface is comparatively level; but it is to be hoped that the slight natural disadvantages of the other provinces will not deter them from endeavouring to rival a province which has set them so noble an example, and the improvements and cultivation of which have gained to its population a degree of wealth and refinement unequalled by the other inhabitants of the country. The quantity of land belonging to the monasteries, which may or may not be cultivated or neglected, as the lazy proprietors incline, and which is excluded from the enterprising efforts of private individuals, may be mentioned among the causes already stated, on account of which agriculture in this kingdom has been so long overlooked or despised.

Manufactures.

Nor are the manufactures of Portugal in a much more thriving condition than her agriculture. The Portuguese manufactures, indeed, are few and unimportant. With the exception of the lower orders of the nation, who are clothed with their domestic manufactures, or with the skin of their sheep, nearly the whole of the population besides may be regarded as furnished with their apparel from England, Holland, and Germany. They, however, export wool to a considerable amount. Extensive manufactories, and those chiefly for woollens, silk, and earthen-ware, are extremely rare: they are in general carried on in separate cottages, on the most limited scale, each district, as it were, manufacturing for its own consumption. The most common manufactories, which the kingdom contains, are those of cotton, linen, woollen-cloths, silk, paper, glass, earthen-ware, salt. Cambrics, shirting and table-linens, and sewing threads, are those in which she principally excels. There is one species of manufacture, however, in which Portugal has obtained great celebrity, namely, that of wine, which is carried on to a great extent, chiefly in the northern provinces. It is probably indeed owing to the great extent to which the vine is cultivated, that their pursuits, particularly those of agriculture, have been so much neglected, as, according to Mr. Murphy, the culture of the vine is four times more profitable than that of wheat or maize. The quantity of wine usually made is about 80,000 pipes of red, and 60,000 of white, annually. Of these wines, about a half are exported to England alone, and the remainder to the different countries in Europe; and formerly a great quantity was sent to Brazil, the average annual value exported being about £2,000,000. The Portuguese themselves generally drink wine of a quality so inferior, that it could not find a vent in a foreign market.

Commerce.

The navigation and commercial intercourse of Portugal are more considerable than her manufactures. The emigration of the court to Brazil, in 1807, deeply injured the interests of the kingdom in this respect. The colonial produce of Brazil was formerly monopolized by the Portuguese, and Portugal formed the emporium at which the imports and exports of that colony met and were exchanged. The exports of Brazil, during the residence of the court there, instead of being imported to Lisbon, and thence distributed throughout Europe, were carried directly to their several places of consumption, without the intervention of the mother country; and on the same principle of exclusion from the parent state, the Brazilians obtained their supplies of European commodities without any connexion with Portugal. The import and export trade of Portugal has for a considerable time been chiefly in the hands of foreigners, particularly British, settled in Lisbon and Oporto. The commercial relation, indeed, between England and Portugal, has long been very important; and the balance, to a great degree, is in favour of England. England exports to Portugal woollens, hardware, salted and dried fish, shoes, stockings, and such articles as can be furnished by a country like England, far advanced in the division of labour, to one in which productive industry is still in its infancy; while Portugal gives in return bullion, coin, diamonds, precious stones, wines, salt, wool, oil, oranges, lemons. Portugal has a very trifling commercial connexion with any of the other countries of

Europe; but she trades pretty extensively with her colonies, with the United States, and the East Indies. The internal trade of this country is much limited, as previously stated, by the badness of the roads, the want of canals and bridges, and the difficulty and precariousness of river navigation.

Colonies.

The colonial possessions of Portugal, it may not be improper to mention in this place, are the Madeira, the Azores, and Cape de Verd islands, with some settlements in Africa, as Guiana, Angola, Mozambique; and in Asia, Goa, Timor, and Macao. The Asiatic settlements may be regarded as mere relics of former great splendour and importance. Of the recent revolution in Brazil, long the most important colony of which Portugal was possessed, an account may be found in a subsequent portion of this article.

Cities.

Of the cities and towns of Portugal, an account may be found in this work under separate heads. Referring the reader to these articles, we need merely at present mention that the most important cities are Lisbon, the capital, situated on the Tagus, and containing 230,000 inhabitants;* Oporto, lying on the Douro, and amounting to 65,000; Coimbra, on the Mondego, containing 15,000; Elvas, on the Guadiana, 16,000; Evora, Braga, Setubal, about 12,000 each; and that the other towns and villages, (and their number extends to several thousands,) are small, poor, and thinly inhabited. Braganza, which lies in Tras os Montes, may be mentioned, as it confers the ducal title on the present reigning family of Portugal. The only great sea-ports are Lisbon, Oporto, and St. Ubes, or Setubal. There are many maritime towns, but of an inferior description, being accessible only to small vessels, and possessing scarcely any thing but a mere coasting trade.

Character and habits of the people.

The Portuguese are characterized by different features in the different parts of the kingdom. In Lisbon they are pre-eminently remarkable for corruption, for insincerity and luxury; in the southern provinces they are simple and unsophisticated, polite, but extremely indolent; while in the northern districts they are open, candid, industrious, enterprising, and ambitious. The general features, however, of the peasantry, and the inhabitants of the minor towns, are primitiveness and simplicity, such as may be expected to obtain among a people that have enjoyed little intercourse with strangers, —inactivity, want of enterprise, silence, retirement, dislike to social pleasures, attachment to the higher orders, blind reverence to their priests, and loyalty to their sovereign. Treachery, ingratitude, vindictiveness, have also been uniformly laid to their charge. Notwithstanding their fondness for seclusion, they are hospitable to strangers, particularly if they belong to the Popish church, which is the national religion. The nobility are proud, ostentatious, and tyrannical, displaying that feudal illiberality and despotism which is so baneful to the progress of liberal knowledge and to independence of spirit, and which has now nearly disappeared in all the more civilized countries of Europe. The peasantry are, consequently, in a state of complete vassalage to the Fidalgos, or gentlemen; though, in opposition to this, it may be mentioned, as a favourable indication of character, that the utmost kindness and affability are in general shown to domestic servants, no small number of whom spend their days in the same family. That indolence, for which the nation, with the exception of the inhabitants of the northern provinces, are so remarkable, may probably be accounted for from the endless holidays of the Catholic church, and the general debasing effects of that superstitious creed which it so assiduously inculcates. In Lisbon and the provincial towns there is a total disregard of cleanliness, a thing so remarkable in the capital, that there is not probably another city in the world in which there is so much filthiness and inelegance. This grossness is least perceptible in Oporto. The Portuguese of every rank are temperate, or rather abstemious, both in eating and drinking. The only luxury of the common people is tobacco; and if any of them can reach the height of a dried Newfoundland codfish, he regards himself as at the summit of earthly felicity. In consequence of the beauty of the climate, they spend most of their time in the open air; and their houses, therefore, instead of being, as in Britain, an object of embellishment and care, are plain, or are neglected to a degree inconceivable to a stranger; and the furniture even of the most elegant edifices is indicative of poverty, or a total disregard of taste. The houses even of the most opulent and eminent Portuguese have not yet been distinguished by paintings, or any work of art and genius. Billiards, back-gammon, cards, and dice, have been long known and practised; but their chief amusements are bull-fights in the amphitheatres, a practice common both in Spain and Portugal, and incompatible with great delicacy or refinement of feeling. Mendicity is very prevalent; and beggars will scarcely submit to a refusal, but exhibit a degree of rudeness and pertinacity which ought to be checked and punished. The high nobility are denominated Titulados, the gentry Fidalgos, both, as mentioned above, remarkable for pride and illiberality.

The female character in Portugal is extremely retired, domestic, amiable, and chaste. Their bland and simple manners are not corrupted, nor their attachments dissipated, by an extensive communication with the world. "As to their persons in general," says Mr. Murphy, "they are rather below than above the middle stature, but graceful and beautiful. No females are less studious of enhancing their attractions by artificial means, or counterfeiting, by paltry arts, the charms that nature has withheld. To the most regular features, they add a sprightly disposition and captivating carriage. The round face and full-fed form are more esteemed in this country than the long tapering visage and the delicate frame."—"Cottons, muslins, and coloured silks," says the same author, "they very rarely wear. A kind of black garment, called *mantilha*, over a petticoat of the same colour, both of woollen cloth, or silk, but oftener the former, is the usual dress, except in Lisbon, where the women wear black silk mantos, a kind of garment which covers the head and upper part of the body." Ladies of rank still imitate the industry of their ancestors in spinning flax from the distaff; and the oriental way of sitting on the floor, or on cushions, is often practised. The dress of the men, (who are neither very tall nor very handsome,) is nearly the same as that of the French or English. Their noses are in general round, and their lips thick; and the inhabitants of the southern provinces bear a striking resemblance, in many respects, to the features of their Moorish ancestors.

Language.

The Portuguese language, like the Spanish, is derived from the Latin, which indeed at one period was the language of the whole Peninsula, but it is also composed of many Greek and Arabic words; and in the southern provinces traces may be found of the ancient dialect of the Moors. As the royal line of Portugal was of French origin, there is, as may be supposed, an admixture of various terms of the language of France. It is a grave, solemn, and melodious speech; the use of vowels is predominant, and it is possessed of no guttural sounds; but when a tongue, like the Portuguese, is composed of a variety of dialects, introduced at different periods, and bearing little or no resemblance to each other, a wide difference of style may be expected to obtain between the writers of the different ages. This is the case in a remarkable degree, and constitutes one of the greatest difficulties in obtaining a knowledge of the language; philology is little studied, and no cultivated nation of Europe has produced fewer or more defective lexicons than Portugal.

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* The English, it may be remarked, have a burial ground in Lisbon, in which are deposited the remains of Henry Fielding, the celebrated novelist, who, having visited that place for the benefit of his health, died there in 1754.

rature. But the Portuguese language, whatever be its defects or its beauties, has not been rendered venerable or classical by many works of genius. Literature in Portugal has never indeed been carried to any great eminence; and even though of late efforts have been made to remove that deplorable ignorance in which the nation has been so long sunk, it is yet decidedly inferior to most of the countries of Europe. Yet it has not been entirely barren in men of talents and genius. It has produced many historians of extensive celebrity; Joao de Barros, Diogo de Couto, Fr. Bernardo de Brito, and others. In poetry it can boast of Camoens, a name that would throw a lustre over any country: of Diogo Bernardes, Bacelar, Pereria. It has also produced several dramatic writers; a few mathematicians of eminence; and the department of natural philosophy is now beginning to be assiduously cultivated. But notwithstanding those names, literature and intelligence are not diffused among the great body of the people. Though the university of Coimbra,* which has always been a celebrated seminary, was founded so early as the fourteenth century, and though other colleges were instituted, which have been suppressed during the last century, yet the community were always ignorant and uneducated; newspapers and literary journals, those great vehicles of information and knowledge, are even at this day little known; and schools for the general instruction of the people have not yet been established to the extent necessary. Thirty thousand, it has been computed, are the number at present attending the various schools and seminaries in the kingdom. It has now, however, been ascertained that in every well-educated country one-ninth or one-tenth of the whole population should be receiving education at one time; and as the population of Portugal amounts to 3,600,000, and as 30,000 only are undergoing instruction, consequently no fewer than eleven-twelfths of the people are totally deprived of the means of education. The late revolution, and the various political events of the last fifteen years, have had a very favourable effect on literature and education; the Lancasterian system has been introduced, and very generally adopted, with great success; the number of new publications has increased; literary societies have become more spirited and ambitious; and newspapers and periodical works have become more common, and are beginning to circulate widely among the body of the people. Freedom of the press is not yet established; but the censorship of it has been taken from the clergy, and is now entrusted to a committee of the privy council. This is an important change, and freedom of discussion is allowed in the various departments of literature and science; politics and theology being the only subjects on which restrictions are imposed.

Navigation and discovery. But Portugal, though for the last three centuries she has not been remarkable for intellectual eminence, was, during the century previous to this time, probably the most distinguished nation in Europe in one department of science, and in the branches subservient to it. In the annals of navigation and discovery, Portugal will always occupy a bright page, and it will even be recorded to her honour, that she had the merit of removing one of the most formidable barriers by which Europeans had been so long shut out from a knowledge of a most important portion of the globe. Portuguese scholars at this period studied with assiduity, geometry, astronomy, and geography, the sciences on which navigation is founded; and, under the patronage of Henry, Duke of Viseo (a prince who cultivated the arts and sciences, then unknown, or despised by persons of his rank) and of various members of the royal family, they discovered not only the Madeira Islands, the Cape Verd Islands, and the Azores, and explored the western coast of Africa, but opened a way to the East by the Cape of Good Hope, and discovered Brazil, in South America, which last two events, so honourable to the Portuguese character, and so important in the history of the world, took place within seven years after the discovery of America by the illustrious Columbus. A farther account of the naval achievements of the Portuguese will be given in a subsequent part of this article; and it need only be mentioned at present, that if to the enterprise of her own subjects in the pursuit of discovery, Portugal had added that of Columbus, who applied to her for protection and patronage, she would have earned to herself, in the department which we are considering, a glory and a distinction to which no other nation in the world could produce a parallel.

Religion. The religion of Portugal is the Roman Catholic, maintained to a degree of rigour and superstition elsewhere unknown. Protestants, however, though not tolerated by law, are connived at; liberty of conscience is virtually allowed; nor are even the Jews molested, unless they are peculiarly obtrusive and troublesome. The inquisition, which effectually checks a spirit of liberal inquiry and literary improvement, was established before the middle of the sixteenth century, and continued in great activity till lately, when by some regulation it was abolished. The number of the clergy is usually great; the parishes amounting to 4271, the number of parish priests must be equally great; while in Scotland, a country of nearly the same extent, they are not one-fourth of that number. The Portuguese priests, though not remarkable for vice and immorality, are ignorant and poor, the wealth of the church being appropriated by the prelates and collective establishments. The number of monasteries is 417, containing 14,000 monks; that of convents 150, containing 10,000 nuns. The secular clergy amount to above 22,000. There are two archbishops and thirteen bishops; the archbishop of Lisbon is honoured with the title of patriarch, is a cardinal and chaplain to the king. It may not be improper to state, that in the colonies the Roman Catholic is the established religion, and exhibits the same features as in the mother country. In consequence of the number of monasteries, and the rapacity of the dignified clergy, a large portion of the best land in the kingdom is in the hands of the church; and is thus excluded from the enterprising efforts of private individuals, and the cultivation to which it might otherwise be subjected. The court of Rome participates largely in the ecclesiastical government, reserving to itself the confirmation of the prelates and the regulation of the taxes payable by the church. Some improvements have of late been made. The power of the clergy has been much diminished; their number considerably lessened; the inquisition, as just stated, abolished. The collision of the Portuguese with the English during the peninsular war, has inspired them with more enlightened and liberal views, and has rendered them ambitious of rivalling the more refined nations of Europe in literary attainments, and in civil and religious liberty.

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* George Buchanan, our illustrious countryman, it may not be improper to state, was in 1547, on the invitation of the King of Portugal, appointed a professor in the college of Coimbra. In this situation he continued till 1519, when, having offended the religious prejudices and bigotry of the nation, he was committed to prison, whence, at the end of eighteen months, he was removed, only to be sent to a monastery. It was while in this latter confinement he began and effected his great work, a Latin version of the Psalms, which in purity rivals the composition of the Augustan age.

Revenue.

The revenue of Portugal is estimated at about four millions sterling; an amount sufficiently limited, but fortunately little encumbered by the burdens of the funding system, the public debt not exceeding twelve millions. The sources of this revenue are the customs, the excise, (to which the clergy are subject,) the domains still belonging to the crown, and a monopoly of the trade in tobacco, and formerly of the precious stones of Brazil. The customs are excessively productive; foreign merchandise pays twenty-three *per cent.* on importation, and fish from Newfoundland twenty-five. Fish taken in the neighbouring seas and rivers pays twenty-seven *per cent.*; while the tax upon land and cattle that are sold is ten *per cent.* The king draws a considerable revenue from the several orders of knighthood, of which he is grand master. He also gets the money arising from indulgences, a small return made him by the pope for the large sums his holiness draws out of his dominions. The king, with whom rests the nomination of church dignitaries, reserves to himself a fourth of their income. Some of these sources of royal income are now, in consequence of the Revolution in 1820, either much modified, or are virtually abolished.

Military force.

With this limited revenue, Portugal cannot be expected to possess a large military force. This force has, for the last fifty or sixty years, been gradually increasing, both in number and respectability. "But at the beginning of the war of 1762," we are told by Mr. Murphy, "the army was in a most wretched state, scarcely amounting to ten thousand men; most of whom were peasants, embodied in haste, without uniforms, without arms, asking charity; whilst the officers served at the table of their colonels." And the improvements that have since taken place, both in point of discipline and numbers, have resulted chiefly from the management and command having been put into the hands of foreign generals. Before the late invasion of Portugal by France, the land forces amounted to thirty thousand men; and the marine comprised twenty sail of the line, besides frigates, corvettes, and sloops. During the war, resources were called forth which the nation never had imagined it possessed; and the Portuguese army, during this eventful struggle, recruited by British funds, and disciplined by British officers, became such as to vindicate the former renown of their country. Troops, notorious before for indolence, want of discipline, and filthiness, became cleanly in their persons and dress, skilful and active; and bore no inconsiderable share in routing and expelling the invading armies when their dearest privileges, and their very existence as a nation were threatened. The spirit and firmness exhibited at Busaco, Fuentes, Albuera, Salamanca, will ever redound to their honour, and show that they want only discipline and experience to equal in character British, French, or German troops. The large standing army which Portugal now possesses, affords proof that she has availed herself of the advantages she enjoyed under skilful commanders during the Peninsular war. But since the court emigrated to Brazil, she has allowed her navy to dwindle, insomuch that she has now few large ships capable of warlike operations. Her naval force indeed is not estimated above fifteen frigates.

Cons tion.

Owing to the revolution of 1820, to the counter-revolution which has lately (1823) taken place, and to the consequent unsettled state of the kingdom, it is impossible to say what the present constitution is, or what may be the result of the circumstances in which she is placed. In giving the history of the kingdom in a subsequent part of this article, we shall briefly give an account of these revolutions; and, under the present head, shall confine ourselves to an exposé of the constitution and government, as they existed previously to the year 1820, when the ancient regime was abolished, and a democracy endeavoured to be established in its stead. The former constitution was a hereditary monarchy of the most absolute and despotical kind. The people had no share in the direction of government, in enacting of laws, or in the regulation of agriculture and commerce. Every man was obliged to pay blind and prompt obedience to whatever decrees and laws were promulgated by his sovereign, without even daring to give a hint about the oppression under which he groaned. The great boards or councils themselves, which carried on the administration, had no check or even voice in the measures that were adopted, but implicitly obeyed the orders of the king. Portugal had formerly indeed its cortes or representative body as in Spain; but till 1820, they had not been assembled since 1697, and the legislative, as well as the executive power was vested solely in the monarch. So emphatically indeed was this the case, that the preamble of every new law was in these words: "I, the king, in virtue of my own certain knowledge, of my royal will and pleasure, and of my full, supreme, and arbitrary power, which I hold only of God, and for which I am accountable to no man on earth, do in consequence order and command," &c. The crown of Portugal was hereditary; but "by the fundamental laws," says the writer last quoted, "it is ordained that in case of the king's demise, without male issue, he shall be succeeded by his next brother; but the male issue of this brother shall not ascend the throne without being previously elected king by the states. By the same law, it is ordained that the succession in default of male issue shall devolve on the female line, on condition that the princess marry a Portuguese nobleman. The husband in this case must not assume the title of king till he shall have a male child by the queen. When in her company he shall always take his place at her left hand; and he must never wear the royal crown." The administration was vested in four ministers and secretaries of state; one was president of the treasury, or at the head of the finance department; another minister of the interior; another of war and foreign affairs; the fourth of the marine and the colonies. There were five royal councils which judged without appeal; two for Europe, at Lisbon and Oporto; two for Brazil, at Bahia and Rio Janeiro; and one for Asia at Goa. Each province in Portugal had its separate governor; each city had its own magistrates. The Portuguese laws have been by various writers alternately praised and condemned; but all authors agree that they have always been miserably and partially administered. The salaries of the judges were so small, their love of money so strong, and the probability of escaping detection so certain, that bribery was carried on here to a degree unknown elsewhere; and any crime, however vicious, might, with the help of a little money, be committed with perfect impunity. This character was applicable (and we fear *is* still applicable) both to the superior and inferior judges, and the laws, therefore, were and are uniformly administered in a way rather to promote the purposes of oppression or judicial aggrandisement than those of substantial justice. During the levy of 1809, thousands, who ought to have entered the army, were exempted by means of money; while others, lame and infirm, were obliged, from want of that powerful medium, to take up arms which they could not wield. On the removal of the royal family to Brazil, the councils of state attended him thither; and the king was represented by a regency; the councils by committees.—The prisons of the kingdom are in general in an uncomfortable state. In Lisbon, for example, a number of the cells admit the water of the Tagus, and at high water are regularly inundated to the depth of ten or twelve inches.

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The titles of the Portuguese monarch are numerous and pompous—Don, King of Portugal and of the Algarves on this side and on the other side of the sea in Africa, Lord of Guinea, and of the conquest, navigation and commerce of Ethiopia, Arabia, Persia, India, Brazil, &c. The heir apparent to the throne before the late revolution was Prince of Brazil, while his oldest son was Prince of Beira. The rest of the royal princes are called Infante. The sovereign of this country, however, had originally the title of Senhovia or Lord. The appellation of Don, so old as the eighth century, and at first given only to kings and to individuals belonging to the royal blood, is now assumed by every nobleman and gentleman, and by all persons holding posts of honour under the crown, though it cannot be assumed without the authority of the sovereign. The nobility, named Titulados, are of four classes, dukes, marquises, counts, viscounts. The rank subordinate to nobility is that of the gentlemen or Fidalgos, a class of men that, even more than their superiors, pride themselves on antiquity of descent, cherish feudal principles, and keep the lower orders of the state in a condition of virtual servitude. There are three orders of knighthood; the order of St. Avis, whose origin is coeval with the foundation of the monarchy; the order of St. James, instituted soon after the preceding; and the order of Christ, instituted in 1319 by King Deniz, after abolishing the order of Templars. The knights of these orders enjoy great revenues, the chief sources of which are ecclesiastical benefices *in commendam*, a gross perversion so common in all popish countries. Though these three orders are religious, the knights are at liberty to form matrimonial connexions.

tiqui-

The Portuguese have ever been remarkable for a disregard of antiquity, and for demolishing every edifice that bore the marks of age, at a time when all the cultivated nations of Europe were endeavouring to preserve with veneration every fragment of Greek or Roman genius. In 1721, a royal edict was published, prohibiting, under severe penalties, this barbarous and dilapidating disposition; but unfortunately it was not published till nearly all the monuments of the former glory of the kingdom had been buried in oblivion. History informs us of temples dedicated to Minerva, to Venus, to Ceres, to the Sun and Moon, &c. with the temples and statues of Tiberius, Trajan, Nero, &c.; but of these buildings not a vestige remains. At Chaves, in the province of Entre Douro e Minho, there were lately discovered the remains of a magnificent aqueduct, baths, cisterns, several pieces of columns, capitals, and cornices of jasper, exquisitely worked. From these it is not improbable that some splendid structures once stood there. There is also a bridge leading over the river Tamego to Chaves, which we learn from an inscription was built in the time of Trajan. It is still entire, and is one of the most curious objects connected with the antiquities of Portugal. The temple of Diana, the aqueduct and castellum, in the city of Evora, built by Quintus Sertorius, are deservedly ranked high among the relics of Roman grandeur. This city was surrounded by a Roman wall, which one of the Portuguese kings destroyed, in order, as he pretended, to build a new one, which has not yet been effected. Near the city of Braga are the relics of various structures, of great antiquitity; among others a temple, supposed to have been dedicated to Esculapius. Very ancient coins also have been preserved: the most ancient are supposed to be those of Q. Sertorius, who came to Portugal about eighty-three years before the Christian era. Coins of the different Roman emperors after this date have been found from time to time; but so implacable a hatred do the Portuguese bear to every thing connected with antiquity, that very few have been preserved; those of gold and silver have been melted down; while those of copper, having passed into the hands of tinkers, have been converted to the most low and inglorious purposes. Nor, though Roman remains are the most common and interesting, are Moorish antiquities a-wanting; for castles, fortresses, and churches, erected by that barbarous people, may be traced in almost every town and village of the kingdom. There are also various Moorish coins; but they are mostly of base metal and mean workmanship.

History.

The early history of Portugal, like that of most other states, is involved in obscurity and fable; and though the Portuguese writers lay claim to a regular descent from Tubal, and to other honours which existed only in their own imaginations, yet it is allowed by all impartial inquirers, that we have no authentic memorials of that kingdom, prior to the time of Hamilcar, the famous Carthaginian general. Nor even from this period, which is comparatively recent, have we any regular accounts of its history. All indeed we know with certainty is, that it was conquered by Hamilcar; that it was the scene of various military operations between the Romans and Carthaginians, for the two subsequent centuries; and that in the time of Augustus it was finally conquered by the Romans, and constituted a Roman province. It remained in this state during the first four centuries of the Christian era; but in the sixth, on the downfall of the Roman power, it fell into the hands of the barbarians, who overran the south of Europe, particularly the Goths and Vandals. The Moors from the north of Africa, early in the eighth century, having landed in Spain, extended their conquests to Portugal, which continued in their possession till the eleventh century. The Spaniards, having long struggled to expel these infidels from their territories, and having succeeded in driving them from the greater part of the country, and in establishing the kingdom of Castile and Leon, penetrated into Portugal, and conquered a part of it from its barbarous invaders in the reign of Alphonso VI. of Castile. This monarch having acquired great glory by his expulsion of the Moors, Henry, grandson of the first Duke of Normandy, anxious to share in this glory, passed over into Spain, and entered the service of the Castilian monarch. After signalizing his valour in various engagements, the king raised him to the highest military honours; and the better to attach so brave an officer to his service, bestowed on him his natural daughter Theresa in marriage, and, as her portion, such portions of Portugal as were not in the hands of the Moors. This he governed under the title of Earl or Count, till his death, which happened in 1112, in the seventy-seventh year of his age. The name of Count Henry forms the first great authentic era in the annals of Portugal. And he seems to have been worthy of the success and honours he experienced. On his death-bed he is said to have recommended to his son and successor to protect and propagate the Christian faith; to treat his subjects as his children; to grant them equitable laws, and to cause them to be impartially administered.

Count Henry.

Alphonso I.

Alphonso, who succeeded him, being under age, the kingdom during his minority was governed by the queen-mother, assisted by two able ministers. During this minority, those jealousies and hostile operations which have ever since obtained between the Spanish and Portuguese monarchies, first appeared. Alphonso, however, when he came of age, made peace with the king of Castile and Leon; and although the latter afterwards entered the Portuguese territories, and was preparing to commit great devastations, a reconciliation was again effected on the intercession of the pope's legate, all places and prisoners on either side having been delivered up. The queen-mother, however, was of a disposition incapable of remaining long in peace. After she had made a treaty with her foreign enemies, a quarrel took place between her and her own son, which having terminated in a civil war, not only were her troops completely defeated, but herself was made prisoner; in which situation she continued during the remainder of her life.

Alphonso had not long gained uncontrolled possession of his dominions, when they were attempted to be overrun by the Moors. He was not, however, slow in opposing them. And a general engagement (1139) having taken place on the plains of Ourique, on the banks of the Tagus, the infidel army was overthrown with tremendous slaughter: an event which not only redounded to the honour of Alphonso, but which laid the foundation of the Portuguese monarchy. Alphonso was proclaimed king by his soldiers on the field of battle; a title which he enjoyed till his death, and which was for generations retained by his descendants. At a subsequent period he caused himself, with great ceremony, to be chosen and crowned king before an assembly of the states, on which occasion he solemnly renounced all dependence on the crown of Spain, declaring, that if any of his successors should consent to do homage or pay tribute to that power, he was unworthy of possessing the kingdom of Portugal. But though Alphonso had attained to this dignity, he did not allow himself to enjoy it in inglorious tranquillity. While he made several unsuccessful irruptions into the territories of the king of Castile, (who had now assumed the title of emperor of Spain,) he at the same time continued with unabated ardour to extirpate the Moors, who still were in possession of a great portion of his dominions. Lisbon being in their hands, he reduced it by means of a fleet of adventurers, French, English, Germans, Flemings, who, in their way to the Holy Land, anchored at the mouth of the Tagus, whose assistance he requested and obtained in a cause not entirely foreign to that in which they were embarked. He made many successful expeditions against the Moors, and became master of four of the six provinces of which Portugal now consists. He died in 1185, celebrated for courage, patriotism, and for his love and patronage of learned men.

Sancho.

His son Sancho, who succeeded him, was worthy of his distinguished predecessor. Though, before his accession, he had been remarkable for a restless and warlike disposition, he had no sooner obtained possession of the throne than he became a lover of peace, and began, with great assiduity, to repair or rebuild the cities that had suffered by the late wars, and to make what compensation he could for the injuries and losses his subjects had sustained. But though thus pacifically inclined, the state of the nation did not permit him to remain long in peace. The Moors still infested the southern parts of his dominions, over whom he obtained several signal victories. He added considerably to the extent of his territories; and, at an advanced age, he died with the reputation of the best sovereign that had ever filled the throne of Portugal.

For some time after his death, no event of importance occurs in the Portuguese annals. In the thirteenth century, the Moors were expelled by Alphonso III. from Algarve and the south of the kingdom; and, in the subsequent century, the Portuguese made occasional descents on the coast of Africa with various success. But the wars against the Moors were unhappily succeeded by hostilities with the kings of Castile, which have engendered such implacable hatred between the two nations. The reign of Deniz, (an enlightened and patriotic prince, who is justly denominated the father of his country,) notwithstanding some occasional treaties of peace, may be regarded as almost one continued series of warfare with the Castilians. But at length, in the reign of John I. hostilities between these two nations were carried on, if possible, with greater vigour and animosity. The king of Castile, having laid pretensions to the crown of Portugal, invaded that kingdom at the head of the whole forces of his dominions. Having entered the province of Alentejo, and besieged the town of Elvas without effect, he found it necessary to retire into his own territories, determined, however, to invade Portugal a second time, and lay waste the whole country. But the second expedition was not more successful than the first. He was completely defeated; and John was thus firmly established on the throne of Portugal. The Castilians consented to a truce of three years, which was afterwards improved into a lasting peace.

John I.

History of discovery.

But the fame of John is not confined to his victories over the Castilians, or to successful expeditions made by himself in person into the Moorish territories. These, though they show him to have been a man of talents and courage, are not the events by which he is best known to posterity. With his name the history of navigation and the progress of discovery are inseparably connected: a department of enterprise and skill in which Portugal has gained almost unrivalled distinction. At the period at which we are arrived, the art of navigation was still very imperfect. "Though Africa," says Dr. Robertson, "lay so near to Portugal, and the fertility of the countries already known on that continent invited men to explore it more fully, the Portuguese had not ventured to sail beyond Cape *Non*. That promontory, as its name imports, was hitherto considered as a boundary which could not be passed. But the nations of Europe had now acquired as much knowledge as emboldened them to disregard the prejudices and to correct the errors of their ancestors. The long reign of ignorance, the constant enemy of every curious inquiry, and of every new undertaking, was approaching to its period. The light of science began to dawn. The works of the ancient Greeks and Romans began to be read with admiration and profit. The sciences cultivated by the Arabians were introduced into Europe by the Moors settled in Spain and Portugal, and by the Jews, who were very numerous in both these kingdoms. Geometry, astronomy, and geography, the sciences on which the art of navigation is founded, became objects of studious attention. The memory of the discoveries made by the ancients was revived, and the progress of their navigation and commerce began to be traced. Some of the causes (particularly the inquisition) which have obstructed the cultivation of science in Portugal during this century and the last, did not exist, or did not operate in the same manner in the fifteenth century; and the Portuguese, at that period, seem to have kept pace with the nations on this side the Alps in literary pursuits." (*History of America*, book i.) Such were the circumstances of the age when King John, urged partly by ambitious motives, and partly instigated to the measure in order to find employment for the restless spirit of his subjects, fitted out two armaments, the one destined to attack the Moors settled on the coast of Africa; the other, consisting only of a few vessels, appointed to sail along the western shore of Africa bounded by the Atlantic Ocean, and to discover the unknown countries situated there. The expedition against the Moors ended successfully; while, what was still more important, the vessels sent on the discovery doubled that formidable cape which had terminated the progress of former navigators, and proceeded 160 miles beyond it, to Cape Bojador. "As its rocky cliffs," says the historian just quoted, "which stretched a considerable way into the Atlantic, appeared more dreadful than the promontory they had passed, the Portuguese commanders durst not attempt to sail round it, but returned to Lisbon, more satisfied with having advanced so far, than ashamed of having ventured no farther."

Inconsiderable as this voyage was, it increased the passion for discovery which began to arise. Nor was Portugal deficient in men of talents and enterprise capable of giving it a proper impulse and direction. Not only was John himself anxious to patronize and forward any plan which had for its object the progress of discovery, but Prince Henry, his fourth son, was, from his great talents and ardent enthusiasm, peculiarly formed for espousing a cause which might prove not only beneficial but splendid and honourable. He had cultivated, according to Dr. Robertson, the arts and sciences, which were then unknown and despised by persons of his rank. He had applied, with peculiar fondness, to the study of geography, and had acquired such knowledge of the habitable globe, as discovered the great probability of finding new and opulent countries by sailing along the coast of Africa. Under such distinguished patronage, an impulse was given to the spirit of discovery unknown before, and which was attended with the most brilliant results. Not only were the islands Porto Sancto, Madeira, Cape de Verd, and the Azores, discovered and taken possession of,* but, ere long, the western coast of Africa was traced, and Bartholomew Diaz had descried that lofty promontory which bounds this great continent on the south;—which the discoverer himself denominated the Stormy Cape, but to which the king, his master, as he now entertained no doubts of having found the long desired route to India, gave a name more inviting, and of better omen, the Cape of Good Hope. These great events had taken place during the successive reigns of John, Edward, Alphonso V. and John II.; and, in the reign of Emanuel, the next monarch, Vasco de Gama, a man of noble birth, possessed of virtue, prudence, and courage, was despatched by his sovereign with three vessels, to follow the route which Diaz had pursued, and, if possible, to double that promontory, which was justly regarded as opening a way to the East. After struggling for four months with contrary winds, Gama, during an interval of calm weather, accomplished the object for which he had set out. After doubling that formidable cape, he directed his course towards the north-east, along the African continent. He landed at Melinda, on the Zanquebar coast, and afterwards crossing the Indian ocean, he arrived at Calecut, on the coast of Malabar. And having obtained not only some commodities peculiar to that place, but many rich productions of the eastern parts of India, he returned to Portugal by the same route, and landed at Lisbon in September 1499, two years two months and five days from the time he had left that port, and after having performed a voyage, the longest as well as the most difficult that had yet been accomplished. In about a year after this date, Cabral discovered that extensive country in South America, now known by the name of Brazil, and which till lately formed so important a portion of the territories of the kings of Portugal. This great progress in navigation and in the discovery of unknown regions, of which we have given but a brief sketch, was accomplished ere the termination of the fifteenth century; and the two last important voyages, those of De Gama and Cabral, were performed five and seven years respectively from the time when the New World was discovered by the illustrious Columbus. In the history of navigation Portugal holds an eminent place, both from the number, the early date, and the magnificence of her discoveries; and, as previously mentioned, the only circumstance which prevents her being entirely unrivalled in this great department, is her refusing, though urgently solicited, to patronize and promote that bold voyage of discovery meditated by Columbus, which was, at a subseqent period, undertaken under the auspices of Spain, and which, contrary to the expectation of the Portuguese, forms the greatest

Emanuel.

Discovery of the Cape of Good Hope.

Discovery of Brazil.

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* The Canary Islands had been discovered so early as 1402, by Bethencourt, chamberlain to the king of France. It has been asserted that these islands, and various others said to be discovered by the Portuguese, were not unknown to the Genoese and Venetian navigators in the fourteenth century; but that, as they were not colonized, they were neglected and forgotten. What truth may be in this opinion it is now too late to ascertain.

achievement in the history of the art to which it belongs. Nor was Columbus the only distinguished person in this department that Portugal overlooked. Magellan, a Portuguese, and the first that circumnavigated the globe, was also denied patronage and encouragement in his native country; and having in consequence applied to Charles V. of Spain, that monarch did himself honour by taking him under his protection, and assisting in promoting his bold and interesting design.

The successful voyages of the Portuguese were soon celebrated throughout Europe, and excited the deepest interest.* With some, they roused a spirit of emulation; but the Venetians, with the quick-sighted discernment of merchants, early foresaw, and feared that it would prove the ruin of that lucrative branch of commerce with the East, which had contributed so largely to enrich and aggrandize them. Nor were their fears ill-founded. The Portuguese did not fail immediately to avail themselves of the route they had discovered to India. The wisdom and prudence of King Emanuel was not more conspicuous in the vigorous and judicious measures adopted at home for monopolizing the commerce of that opulent region, than in his nomination of officers to take the supreme command in Asia; men who, for military and political sagacity, for integrity and love of country, have certainly not been surpassed by persons in similar situations. And their measures were not only planned in wisdom, but carried into effect with the greatest activity. In twenty-four years after the voyage of Gama, the Portuguese had rendered themselves masters of Malacca, which was the centre of the trade of the East. They had also formed settlements at Goa and Diu, by which they engrossed the trade of the Malabar coast. In every part of India they were received with respect; in some they had absolute command: and they thus rapidly diverted from its ancient channels the commerce of India, and were also enabled to import into Europe the various productions peculiar to that country, in greater abundance than had hitherto been effected. The Venetians now felt that decrease of their Indian trade which they had dreaded. This state of things they were resolved to counteract. And sensible that their own naval force was inadequate to the task, they incited the Sultan of the Mamelukes to fit out a fleet to attack those unexpected invaders of a monopoly of which he and they had long enjoyed undisturbed possession. But the Portuguese were not unprepared to defend themselves. The formidable squadron sent out against them they encountered with matchless courage, entirely defeated it, and became more thoroughly masters of the Indian Ocean than before. Year after year they extended their connexion with the East, till they established there a commercial empire of great opulence and extent. And Emanuel, who laid the foundation of it, had the satisfaction of living to see it almost completed. Every part of Europe was supplied by the Portuguese with the productions of the East; and this quarter of the globe had now little or no intercourse with India except by the Cape of Good Hope.

John III.

Emanuel, who died in 1522, crowned with years and glory, was succeeded by his son John III. a prince who extended his acquisitions in India, colonized the Brazils, and effected some salutary improvements at home. But the praise, to which in other respects he is entitled, is much qualified, if not entirely annulled, by his introduction of the inquisition: an event to which, in no mean degree, the rapid subsequent decline of the Portuguese monarchy is to be attributed. From this date, the Portuguese annals are distinguished by nothing that is great or splendid. Sebastian, who succeeded John (1557), was partly from natural dispositions, and in part from a defect in his education, remarkable for rashness, obstinacy, and want of discrimination. Wishing to distinguish himself in a war against the infidels, he undertook two crusades into Barbary. For this purpose he levied large armies, he induced the principal nobility to rally round his standard, neglected all domestic and internal improvements, and thus sacrificed the true interests and hopes of his kingdom to personal vanity and the meanest ambition. And continuing inflexible in his purpose, in opposition to the importunities of his allies and more judicious subjects, he left Lisbon (1578) with a formidable fleet, and having landed in Barbary, was met by Muley Moloch, the Moorish king, and defeated with incredible slaughter, himself slain, and his army either cut off or taken prisoners. By this signal defeat, the kingdom was at once exhausted of men, money, and reputation, and placed in circumstances to become an easy prey to the ambition or rapacity of any state that might wish to make the attempt. Cardinal Henry, who succeeded Sebastian, reigned only two years; and the male line of the royal family having become extinct, and the kingdom being completely devoid of resources for self-defence, Philip II. the celebrated king of Spain, soon succeeded in adding it to his paternal dominions, though various attempts were made by the people to retain their independence, and though Elizabeth, queen of England, fitted out a fleet to drive Philip from the territories he had so unjustly seized. The Spanish monarch, however, having in opposition to every obstacle, firmly seated himself on the throne of Portugal, granted his new subjects a form of government and laws, in their spirit and tendency sufficiently enlightened, but which were afterwards perverted by him and his successors to the great prejudice of Portugal, which they evidently wished to mould at length into the character and circumstances of a province of Spain. In this situation Portugal long remained in a state of complete subjection and humiliation at home, and exposed in her colonies both in India and Brazil to the inroads of the Dutch, at that time the most enterprising naval power of Europe. This state of things, however, was at length to have an end. Portugal had all along submitted with reluctance to a foreign yoke; the Spanish monarchs showed themselves unworthy of their new acquisition, by the illiberal and tyrannical policy they adopted; and the Portuguese, roused at length by many injuries, and a native love of liberty, made a successful insurrection in 1640, expelled the Spaniards from their territories, and conferred the crown on the Duke of Braganza, a descendant by the female line of the royal family. This revolution, which forms so important an era in Portuguese history, being the almost unanimous voice of the nation, was attended with little or no effusion of blood. Nor were all the attempts of the king of Spain able to regain possession. A fierce war between the two kingdoms raged for many years. Portugal gained several distinguished victories; and at length, in 1668, hostilities were terminated in favour of Portuguese independance, through the interposition of Charles II. king of England, who had married a princess of Portugal. For a full and interesting account of this revolution, and the events connected with it, the reader may consult *Histoire des Révolutions de Portugal*, par Vertot.

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* The voyage of Gama forms the subject of the Lusiad, the celebrated epic poem of Camoens, published about the middle of the sixteenth century. Who can cease to regret, that Columbus, a much more interesting and illustrious character, was allowed to be laid in the grave "unhonoured and unsung?"

Alphonso was successor to the Duke of Braganza, who had reigned under the title of John IV. Alphonso being of a weak constitution, of great imbecility of mind, ill-educated, and addicted to mean company and low pleasures, his mother endeavoured by every artifice and intrigue to get him deprived of the crown, which she meant to place on the head of his younger brother Don Peter. This she was unable to accomplish: but after her death, Alphonso, from various circumstances, was compelled to sign a resignation of the kingdom; and his brother was declared regent, and invested with all the powers of royalty. Alphonso's wife having transferred her affections to Don Peter—a circumstance which had led her to induce her husband to submit to the resignation—their marriage having been declared null by the chapter of Lisbon, and the regent having gained a papal dispensation, and the consent of the states, married the lady who had been his brother's wife. On the death of Alphonso, the regent succeeded by the title of Peter II. Peter having died in 1706, was succeeded by his son John V. In 1750, on the death of John, Don Joseph ascended the throne, a prince whose reign, though not distinguished for any thing enterprising or heroic, is probably one of the most memorable, but most revolting periods in Portuguese history. It is deeply stained with domestic blood, and rendered odious by the most shocking cruelty. In 1758, the king was attacked by assassins, and narrowly escaped with his life. The families of Aveira and Tavora, in consequence of an accusation (afterwards proved to be unfounded) exhibited against them of having conspired against his majesty's life, were cruelly destroyed by torture. On various pretences, execution succeeded execution with awful rapidity. An earthquake overwhelmed the city of Lisbon, and shook the whole kingdom to its centre. A famine threatened to accomplish what this visitation had left undone. And in addition to these and similar calamities, the Portuguese dominions were invaded by Spain with a powerful army; their capital threatened; their prince almost determined to save himself by flight; evils from which they could not have been saved, had not England interposed to bring about a peace, which was concluded in 1763. During this reign, the management of public affairs was in the hands of the celebrated Marquis de Pombal, a minister of unbounded authority, which he not unfrequently directed to the most cruel and arbitrary proceedings, and whose removal from office in the subsequent reign excited joy throughout all ranks of the community.

Joseph, who died in 1777, having left no sons, was succeeded by his daughter Mary, whom he had married, by dispensation from the Pope, to Don Peter her uncle, with a view of preventing the crown from falling into a foreign family. The queen having fallen into a state of religious melancholy, the prince of Brazil published an edict, (1792) declaring, that as his mother, from her unhappy situation, was incapable of managing the affairs of government, he would place his signature to public papers till the return of her health, but that no other change should take place in consequence of her indisposition. From this unhappy state she was doomed never to recover; she attained, however, to very advanced years; and at her death was succeeded by her son, the present reigning monarch. In the beginning of the late war with France, Portugal took a feeble part conjunctly with England and Spain; but after Spain had made peace with France, a war took place between the former country and Portugal, which however was productive of no very important events, and which was terminated by treaty in 1801. On the rupture of the peace of Amiens, and the renewal of the French war, Portugal remained for some time neutral; but having at length determined in favour of France, she advanced from time to time large sums of money to that power, and at last went so far as to order her ports to be shut against the ships of war, and merchant vessels of England. She now found herself placed in peculiar and extremely dangerous circumstances,—virtually at war with Great Britain, a power with which she had for centuries been intimately connected, whose friendship had often averted from her impending ruin, and from whose hostility she had every thing to dread,—and leagued with France her ancient enemy, in whom she could place no confidence, and whose armies, having invaded Spain, were rapidly advancing to Lisbon, to possess or to destroy it. In such circumstances the government hesitated long what steps to adopt. Distrustful of Bonaparte,—expecting no assistance from any foreign power, and aware that the internal resources of the nation were inadequate to its defence, the royal family of Braganza abandoned a kingdom which they could not defend, and emigrated to Brasil. In November 1807, they sailed from the Tagus, in a fleet of eight sail of the line, carrying with them about 18,000 Portuguese subjects, including many persons of distinction. And from this period, Rio de Janeiro, the capital of Brazil, may be regarded as the seat of the Portuguese government. On the removal of the royal family, the councils of state attended them; and the king was represented in Lisbon by a regency, and the councils by committees; and no other important alteration took place in consequence of the departure of the court to the Brazilian colony.

John VI.

Royal family remove to Brasil.

Nor were the views of the king of Portugal in regard to the views of Bonaparte unfounded. The French immediately took possession of Lisbon, and the administration of the new government was conferred on Junot, now dignified with the title of Duke of Abrantes. They were not, however, allowed long to retain possession of the Portuguese territories. England, having resolved to assist Spain and Portugal in their resistance to French usurpation, despatched an army to the latter country, and having defeated the enemy at Vimeira, compelled them to evacuate Portugal by the convention of Cintra. Portugal, however, was not yet freed from foreign aggression. The invading armies of France having met with considerable success in Spain, having taken Madrid, and forced Sir John Moore to make a precipitate retreat from the peninsula, Portugal was again attempted to be overrun and subdued. Three armies were collected on its frontiers, one under Marshal Soult in Gallicia, another under General Lapisse at Salamanca, and a third on the banks of the Tagus, under Marshal Victor. Had these armies been concentrated, and placed under the management of one commander, the object the French had in view, notwithstanding the bravery of the Portuguese and Eng-

French invasion of Portugal.

POSEN, or Posna, the capital of Russian Poland, is situated at the confluence of the Wartha and the Prozna. The town is upon the whole regular, and is encircled with a mound and ditch. The principal public buildings are the cathedral, the council-house, the principal guardhouse, the cidevant Jesuits college, a theatre, a gymnasium, a college for rearing teachers, and a school for midwifery, several churches and convents, and the episcopal palace, which is a fine structure. The castle stands on an island in the Wartha. The principal manufactures are linen goods, leather, watches and fire-arms; and corn, wool, and timber, are the chief articles of export. Population about 20,000. East Long. 16° 33′ 56″, and North Lat. 52° 24′ 39″.

POSITION, is the name of a rule in arithmetic, by means of which an unknown number is determined by means of one or more *suppositions* or assumed values of it. Position is divided into *single* and *double*.

In *single* position, the false conclusion is to the false position as the number given is to the number sought. Thus,

Ex. A manufacturer being asked how many workmen he had, replied, that if he tripled the number he had, and added one-eighth of his number to that, he would have 150.

Let us suppose 32 to be the number, then $32 \times 3 + 4 = 100$ instead of 150. Consequently 100 the false conclusion, is to 32 the false supposition, as 150 is to 48, the true number of workmen.

In double position the answer is obtained by *two* suppositions. The rule, therefore, is to assume two different numbers, and subject them to the conditions given in the question. Then the difference of the results thus obtained, is to the difference of the assumed numbers as the difference between the two results, and either of the others is to the correction to be applied to the assumed number, from which the result was obtained. This rule was given by Mr. Bonnycastle in his arithmetic, published in 1810.

The following more general rule has been given by Mr. Thomson of Belfast, in his very useful treatise on the theory and practice of Arithmetic.

"Having assumed two different numbers, perform on them separately the operations indicated in the question, and find the *errors* of the results. Then as the difference of the errors, if both results be too great or both too little, or as the sum of the errors if one result be too great and the other too small, is to the difference of the assumed numbers, so is either error to the correction to be applied to the number that produced that error."

As all the questions that are capable of being solved by these rules, can be done with more facility by the simplest rules of algebra, it is needless to occupy any more space with their illustration. The principle on which they rest is quite correct, for all questions which can be resolved by a simple equation, but in relation to other equations, the rules give only approximate results. See Algebra, Vol. I. Sect. IV. p. 429.

POST Office. See England, Vol. IX. p. 21.

POTASH. See Alkalis, Vol. I. p. 526; Chemistry, Vol. VI. p 44, 45; and Materia Medica, Vol. XIII. p. 352.

POTASSANE. See Chemistry, Vol. VI. p. 65.

POTASSIUM. See Chemistry, Vol. VI. p. 44.

POTATOES. See Agriculture, Vol. I. p. 304—307; and Horticulture, Vol. XI. p. 253—256.

POTOSI. See Buenos Ayres, Vol. V. p. 52, 53, &c. and the books quoted under that article.

POTSDAM, a city of Prussia, in the Middle Mark of Brandenburg, and the capital of a province of the same name. It is situated on the north bank of the Havel, which forms, as it were, a series of lakes round the town. The city, which has the general form of a square, is divided into the Old and New Town. The Old Town contains only four streets. The New Town was chiefly built by Frederick II. The streets of it, though regular and spacious, are not well paved; and several of them have such magnificent fronts as to resemble rows of palaces, though the houses are inferior within, and are inhabited by ordinary persons. A ditch and wall encircle the town; and there are four gates towards the land, and four towards the Havel. The palace, which is the chief public building, stands on the margin of the river. It is a noble building, and was begun in 1660. A colonnade, a cupola, and a marble staircase, are among its principal ornaments. Its extensive gardens stretch along the river; and on the front of it is a square for exercising the troops of the garrison. It has also a theatre, a menagerie, and spacious stables. The town-house, on the plan of that of Amsterdam, was built in 1754. The town-church, situated not far from the castle, is a fine building. Besides other five churches and a synagogue, there is the garrison church, which is large, and contains statues of Mars and Bellona. Under the pulpit, which is constructed of marble, is the monument of Frederick William. In the market-place, which is ornamented with the statues of the kings of Prussia, is a pyramidal obelisk of four sides, seventy-five feet high, and made of variegated Silesian marble. On one side is a marble bust of the king; and at each corner of the pedestal, which is of white Italian marble, is a statue of the same marble. The places of public instruction are, a lyceum, two public schools, and the garrison school. There is here an infirmary, a poors-house, and an orphan-house. This last building, founded in 1724, maintains and educates 2000 soldiers' children of both sexes, and has one Lutheran and one Calvinist preacher attached to it. The principal manufactures of Potsdam are those of cotton-lace, silk, velvet, linen, woollen, wax-cloth, leather, hats, and fire-arms for government. Brewing is carried on to a great extent. The palace of Sans-Souci is about three-fourths of a mile distant from Potsdam. It is only one story high, with a round pavilion at each end; in one of which is the library, as it was left by Frederick II. at his death. There are two adjoining buildings, one for paintings, and the other for court entertainments.

The population of Potsdam is about 15,000, besides about 7000 soldiers. Distance from Berlin 15 miles, S.W. East Long. 12° 5′ 1″, North Lat. 52° 24′ 43″.

Definition.

POTTERY, called also earthen-ware, is a term used to denote vessels of any shape or size formed of earth or clay; or the art of manufacturing them. Pottery may be regarded as merely the coarser species of porcelain. The articles of the former manufacture, while they require fewer materials, and these less pure, though more fusible, require also much less skill and delicacy in the making; are incomparably cheaper, particularly the coarser kind; are ruder and more inelegant; and are, from the grossness of the materials of which they are formed, unsusceptible of the high ornament and polish, characteristic of porcelain.

Origin.

These articles, however, though devoid of the beauty and delicacy of porcelain, must have been invented at the very remotest periods of human society. Porcelain had attained to great distinction in China very soon after the Christian era; but pottery, a thing of indispensible daily use, must have been invented long ere refinement could have dreamt of a manufacture so elegant and so complicated as porcelain. In the infancy of society, the very first want that men would feel, would be vessels capable of holding his meat and his drink: such vessels were probably at first made of the skins of beasts caught in the chase, or were excavated out of wood; but the art of making such articles of earth, though perhaps not immediately invented, must have been well known at a period extremely early, and of which no traces could come down to us. As the Chinese were unquestionably the inventors of porcelain, we may suppose, with sufficient probability, that pottery was early brought by them to great perfection; and that indeed the knowledge of the latter paved the way for the knowledge of the former. Pottery also at a remote period attained to great distinction among the Egyptians, from whom it naturally descended to the Greeks and Romans. The latter people indeed carried the art to a degree of perfection which in some respects it has not yet surpassed, and which induced the late celebrated Mr. Wedgewood to name the village that grew out of his industry and genius *Etruria*, after the district in ancient Italy that had cultivated the pottery manufacture with the greatest ardour and success. At what period the art was introduced into Britain cannot be exactly ascertained. The first place where it is known to have been practised was Burslem, in Staffordshire, mentioned (1686) by Dr. Plot, as the principal pottery institution in this country. The art at that time seems to have been in its rudest state, the ware being all extremely clumsy, the colours both coarse and very unskilfully applied, the glazing consisting entirely of lead ore, or calcined lead, a substance uncommonly pernicious and dangerous. The year 1690 forms a kind of era in the history of this manufacture in Britain; for at that period two brothers from Holland, of the name of Eders or Ellers, settled in Burslem, extended the former establishment to a great degree, and accomplished several improvements and discoveries. These two individuals, however, from a misunderstanding with the neighbouring inhabitants on account of the fumes which their furnaces emitted, soon retired to their native country; but the effects of their ingenuity and enterprise remained behind them; and they were succeeded by men who, availing themselves of their example, were equally persevering and successful. But it was not till 1763 that the most important and memorable improvements were made in the art. The person by whom these were effected was Josias Wedgewood, a gentleman of great science and great industry, whose name is known throughout Europe, not merely for his inventions and discoveries in the manufacture of pottery, but for the benefits he conferred on natural science in general. Of the inventions and improvements of this celebrated person, an account may be found under the article WEDGEWOOD; and it need merely at present be mentioned, that, prior to his time, the pottery of this country was, comparatively speaking, destitute of taste, beauty, and utility; that manufactories of this article are now established in various parts of England; and that what is denominated the Potteries in Staffordshire, a place eight miles long and six broad, containing fifteen large manufactories, of which one is Etruria, founded by Mr. Wedgewood, and now the property of his sons, are the most extensive, opulent, and celebrated in the kingdom.[*]

Ingredients.

The ingredients in the manufacture of pottery are clay and flint, with other subordinate substances, inseparable from the two ingredients just specified. These clays or natural compounds, to which vessels owe their ductility or capability of being moulded to any form, are found to consist of pure clay or alumine, silex, lime, sometimes magnesia, and not unfrequently of oxyd of iron; in which ingredients the alumine predominates to an incomparable degree. The flint, used in this manufacture, is the common kind for striking fire, and consists almost entirely of pure silex, with minute and almost indiscernible traces of alumine, lime, and oxyd of iron and water. The finest stoneware, therefore, is made of the purest pipe-clay, and the purest flint. When in the clay, the oxyd of iron occurs, the pottery made of it burns to different shades of red, in proportion to the quantity of iron. Magnesia, when combined with the clay, gives to it a soapy character; from which it has been denominated soap-rock, a particular kind being called steatite. The clays of which the Staffordshire ware are manufactured, are brought from Dorsetshire and Devonshire, the former affording clay of a superior quality to the latter. The clays of both places, however, are distinguished by almost every property necessary to the purpose to which they are applied, particularly for extreme whiteness when burnt; a circumstance which results from their being free from iron, a metal which, as just stated, imparts a reddish or yellowish colour. The worst and cheapest species of stoneware made in this country, is formed of the common clay of which bricks are made. It can be glazed, as the superior kinds, and converted to many different purposes; but, in an unglazed state, it is used for garden-pots, tiles, and tubes for draining land.

Preparation of these ingredients.

The clay undergoes such a preparation at the place where it is procured as to free it from stones, and the grosser impurities. When brought to the manufactory, it must be rendered still more pure; an object which is accomplished by means of machinery. The clay having by machinery been reduced to small pieces, approaching to a coarse powder, is transferred to a vat, for the purpose of being mixed with water. By constant and continued agitation in this vat, the finer parts of the clay amalgamate completely with the water, and form a fine pulp; while the gross and strong particles, from their gravity, remain at the bottom as refuse. The pulp is now conveyed from this vat through a series of sieves of different degrees of fineness, and moved backward and forward by machinery, till the grosser parts are entirely separated from those of which the stoneware is to be composed.

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[*] The Pottery, or the Potteries, which, as mentioned in the text, comprehend an area of about eight miles by six, is so named from the numerous and extensive manufactories of earthen-ware it contains, and for which, especially at an early period, its situation and soil were peculiarly favourable. The soil in every direction presents a great variety of clays of the finest sort, of which, at one time, though not recently, pottery was formed; while the coarser kinds are still appropriated to make saggars for burning the ware in, and to construct the kilns. This place also abounds with rich and inexhaustible strata of coal. These advantages in favour of one particular manufacture, and the unfitness of the soil for the purposes of husbandry, are evidently the reasons why this district was selected for the object to which it has so long been converted. It was appropriated to earthen-ware manufactories at a remote period, as mentioned in the text: since the days of Wedgewood, however, it has attained to its greatest eminence; and, in proportion to its extent, it is now the most populous and most prosperous spot in the empire. The inhabitants, amounting to about 30,000, are industrious and sober, and, as is the case in most manufacturing places, remarkable for great diversity of religious denominations, of which methodism is the most prevalent. The principal towns, in each of which are extensive manufactories, are Etruria (Mr. Wedgewood's seat) Burslem, Stoke, Hanley, Shelton, Golden-Hill, New-Field, Smith-Field, Tunstall, Long-Port, Cobridge, Lane-End, Lower-Lane, Lane-Delf. (Shaw's *History of Staffordshire*, fol. vol. 1.)

Flint, as already mentioned, is an indispensible ingredient in the composition of stoneware. In preparing it, it is first placed in a kiln and raised to a red heat, when it is thrown in this state into cold water. This process is to diminish its cohesiveness, that it may be the more easily reduced to powder. The flint is now, by a process exactly similar to that described in regard to clay, reduced to a pulp, and the gross parts separated from the fine, which latter is that used in the formation of the ware. This pulp, as well as that of the clay, must always be made into a certain consistence, with a view to ascertain exactly what quantity of each is contained in a given measure. The two pulps are now mixed together in such proportions that the flint is as one to five or one to six of clay; and they are caused to amalgamate by an operation similar to that employed for mixing clay and water, as recently described.

Flint and clay being thus mixed, the next step is to separate the water from them, which is effected by evaporation. When the operation has been continued till the substance is sufficiently dense and stiff, it is cut out in cubical figures, and subjected to a process, the object of which is to render the mass of uniform consistence, and fit for working. This result may be attained either by the hand, or more easily and efficiently by a machine formed for the purpose. The nature of this operation is simple. A mass of the consistence is taken between the two hands, and being separated is re-united with great violence, but at different parts from those at which it was disjoined. It is again separated and again united, and, as before, the points of contact must be different. This process being repeated twenty or thirty times, the mass has assumed such a uniformity in its different parts, that though it originally consisted of two pieces, one black and the other brown, the colour of both at the end of the operation will be exactly and entirely the same. The masses thus mixed and prepared, are allowed to remain some time ere they are converted into vessels, it having been ascertained that they work the more easily from continuing a while untouched while in this state.

Various ways of forming the ware. Throwing.

These substances it is now the duty of the potter to form into articles of various shape. This may be effected in one of three ways, either by throwing, pressing, or casting. The first of these, or throwing, is performed on a machine, denominated the potter's lathe, of which there are two kinds, in both of which many important improvements were made by Mr. Wedgewood. The ware to be made in this way are first roughly formed on one of these lathes, and after this operation, are allowed to dry to a certain extent; but when they come to what is called the green state, or to a given degree of tenacity and stiffness, they are applied to the other lathe, called a turning lathe. The vessels are on this lathe turned to their proper shape, and obtain a considerable degree of smoothness, and when removed from it, are burnished with a smooth steel surface. The same degree of dryness at which the vase requires to be applied to the turning lathe, is also the proper state for fixing on the handles and other appendages. These parts, previously made and reduced to a proper degree of dryness, are attached to the vase by means of a pulpy mass of clay mixed with water, termed *slip*. All kinds of mountings, however, are formed on the wheel or lathe by applying to the vessel when the wheel is turning round, a piece of wood or iron of the form meant to be communicated. The juncture is smoothed with a wet sponge. The vessels are now removed to a stove, varying from 80 to 90 degrees of temperature. Articles of a superior quality, when fully dried in this stove, are rubbed over with a small bundle of hemp, in order to smooth them thoroughly, and to remove those inequalities by which the surface may be marked.

Pressing.

Vessels of a circular form are the only kind made by throwing or by the lathe. Those that have flat sides, or are of an oval shape, are the result of the second method, or of pressing, which is done with moulds. The moulds, which are made of plaster, consist of two separate halves, one half of the figure being respectively on the two sides of the mould. The clay is formed into two flat pieces, of the thickness of the vessels meant to be made; these pieces are now pressed severally into the two sides of the moulds; the halves of the moulds being now brought together, the clay is also united; and after a complete juncture has been effected, the mould is removed, and the vessel has attained its proper shape and figure. The vessels are now polished, are, if thought proper, adorned with handles, spouts, &c. and are removed to the stove, as in the former operation.

Casting.

The only other way of producing this ware is by casting, which is simple as those already described, and regarded by some as producing vessels of greater elegance. The pulp is poured into a mould of plaster till the cavity is quite full. That part of the pulp contiguous to the mould, which must be of a certain degree of dryness, is absorbed, leaving the clay or sediment on the surface of the mould of considerable consistence. The liquid part of the pulp is now poured out; that which remains becomes rapidly stiffer, and in a few minutes, the moulds being removed, the vessel is completely formed, its exterior being the exact shape of the mould, and its thickness in proportion to the time allowed to the operation. These vessels, after being polished and receiving handles, &c. if thought necessary, are transferred to the stove; and as, in the former instances, are, when sufficiently dried, ready for the kiln, to be converted from a soft and tender state to a hard substance called *biscuit*.

Kiln or furnace.

The next step of the process, therefore, is the subjecting of these vessels to heat in the kiln; a building of a cylindrical cavity, with a flattish dome, differing somewhat in its external, and a little in its internal, arrangement from the furnaces described under the article Porcelain, but conducted so much on the same general principles, that any minute description of it here would be unnecessary. The vessels are here, as in the porcelain manufacture, put into cases or saggars, and arranged in piles, leaving sufficient interstices for the flame to insinuate itself equally in all directions. The fire is continued from twenty-four to about forty-eight hours; the saggars are not removed till perfectly cool; and the ware, when brought from the kiln, is termed biscuit; a state in which it is unfit for use, being so permeable as to be accessible to water and other liquids. In making the commonest stoneware, however, it may be remarked, that the vessels are placed in the kiln, exposed to the naked fire without being defended by saggars.—This property of earthen ware, it may not be improper to state, has been applied to the construction of vessels for cooling wines and other liquids, it having been ascertained that the water, by passing constantly from the inner to the outer surface, is carried off by evaporation more hastily than could be done on any other principle.

Before this permeability, however, is removed, which, as shall be shown, is accomplished by glazing, the vessels are to be printed, a process that must be performed while they are in a state of biscuit. The designs are engraven on copper-plates, and prints taken from these as in common copper-plate printing. The surface of the paper meant to receive the impression must be rubbed with soft soap. The colouring, whatever be its hue, is, when diluted with some colourless earthy matter, ground up with boiled linseed oil, until its consistence when laid on the plate be that of soft paste. The paper, covered, as just stated, with a thin coat of soft soap, is now laid on the plate, and passed through the rolling press. The printed parts of the paper, cut out and moistened, are applied to the biscuit, and the colouring matter is immediately absorbed by the porosity of the biscuit. The paper being washed from the biscuit, the colour will now be seen very distinct and regular on the surface of the pottery. The colour is generally made of oxyd of cobalt, which makes the figures of a bluish hue; a colour which causes the white of the vessel to seem more pure and beautiful. This kind is denominated the blue and white ware, and constitutes an important branch of the Staffordshire manufacture. A small mixture of the oxyds of iron and manganese imparts to the figures a dark colour; which is sometimes done, and has by no means an inelegant effect. Printing, it may be observed, was formerly performed after glazing; in which case they had again to be subjected to fire, as in the porcelain manufacture. In some potteries, pencilling, that is, laying on the colour with enamel after the glazing, was at one time practised to a considerable extent; but this mode being very expensive, is now comparatively disused.

The vessel being thus printed, its permeability must be removed by glazing, or by covering its surface with a vitreous substance. An almost endless variety of materials may be used for this purpose, according to the colour or the transparency required, or the quality of the vessel that is to undergo the operation. One species of stoneware is glazed simply by throwing sea-salt (muriate of soda) into the furnace in which it is biscuited. The salt, it is probable, is decomposed, the acid flying off, while the soda combines with the earth of the pottery, forming a vitreous coating. This pottery might be extended for culinary purposes. From not being in saggars, as previously stated, the vapour and smoke come into immediate contact with the ware; and hence it is of a brownish colour. Pounded glass also forms an excellent glazing; it is very transparent, and hence the colour of the vessel is easily seen through it. Ware glazed with this latter substance is termed cream-coloured, as it exhibits a yellowish hue from the presence of a small quantity of oxyd of iron. Glaze may be rendered of a bluish tint by the presence of tin or arsenic, and a small portion of oxyd of cobalt. Glazing, except in the first case, when sea-salt is used, is uniformly performed by mixing the substances of which it is composed with water, so as the whole may assume the consistence of cream; and the vessel, when in the state of biscuit, being dipped into this liquid, the water of the glaze is absorbed by the pores of the biscuit; and if the vessel has been turned with sufficient regularity, a coat of glazing, of uniform thickness, will be deposited on the surface. The vessel also, when taken out of the liquid, must still be continued to be turned, to prevent the glaze from running into ridges. The ware is again placed in the saggars as before, and removed to the kiln; but the fire is neither so strong nor so long continued as before, the object being only to bring the glaze into perfect fusion. These glazes, however, are subject to some objections, particularly their not expanding and contracting equally with the ware; hence the vessels are frequently known to crack, and even the glaze to peel off; and the surface thus rendered permeable to fluids as when in a state of biscuit. The oxyd of lead, however, removes this objection; but this oxyd, even in its vitreous state, and when combined with flint or clay, is easily soluble in acids, and possesses poisonous qualities; so that it is now as little used as possible, and bad consequences have often taken place from eating pickles kept in jars glazed with lead. Lead, however, cannot be entirely dispensed with. All the coarser kinds of pottery at least are glazed with this substance, which, it may be remarked, promotes the fusion and vitrification so rapidly, that a very low degree of heat is required to effect the operation. When the ware is removed from the kiln, it is considered as finished, and as fit for use.

Roman glaze.

The modern mode of glazing seems to be decidedly inferior to that practised by the Romans. Modern glaze, as already shown, cracks, and often scales off, and, besides, it is easily destroyed by acids. The Roman glaze, on the contrary, from specimens of it seen on urns dug up in several places, was entirely free from this defect. The ingredients of which it was composed cannot now be ascertained, though some have supposed that it was made of some species of varnish; while others have insisted, on the authority of some vague expression from Pliny, that it was obtained from bitumen. However this be, it is evident, at least, that it never lost its original beauty, or, probably, that it improves by time, and that it was so much valued among the Romans that some statues were at length glazed with it.

There is, however, a species of very coarse porcelain which does not require to be glazed at all, and which is of a yellowish tint, from a portion of oxyd of iron being used in the composition of it. It does not undergo glazing, because, without this operation, it is extremely and impermeably dense and compact in its texture: a property which results from using a comparatively small quantity of flint in the manufacture of it, and from giving it a greater degree of heat than usual in the burning. Glazing is really but a miserable imitation of a polished surface; and the pottery in question, scarce as it is, is the more beautiful on account of its being devoid of the vitreous covering. This species of ware is confined chiefly to bottles, particularly those used for soda water and artificial mineral waters.

New species of pottery called *lustre.*

A new species of pottery has of late been introduced, denominated *lustre;* which consists in fixing gold or platina on the surface of the glazing, in the following manner: Dissolve platina in equal quantities of the nitric and muriatic acids with heat. When to this solution a solution of muriate of ammonia is added, the yellow precipitate will fall to the bottom. Continue to add the latter till no more is precipitated; drive off the water by heat, and the powder thus obtained must be ground with a small portion of enamel in oil of turpentine; and, after this preparation, it is in the state fit to be applied to the earthen ware. It must be spread thinly over the glazed surface; and the vessel, having afterwards been exposed to the heat of an enamel kiln, or a red heat, the platina assumes its metallic form, and acquires greater brilliancy from the presence of the glaze. The precipitates of gold are applied exactly in the same way; but gold does not afford nearly so brilliant a lustre as the platina, and exhibits, indeed, more the colour and symptoms of copper than of gold.

Similarity between pottery and porcelain.

The preceding discussions on the manufacture of pottery are, in every respect, applicable to the cognate subject of porcelain. Substances, the same naturally in form, and requiring a similar mode of preparation as the kaolin and petuntse of the Chinese, are unknown in this quarter of the world. European porcelain, like stone-ware, is, as specified in the foregoing observations, made of the finest species of clays and silex or flint, substances analogous to those of which the china-ware is formed; and these ingredients are prepared, amalgamated, biscuited, glazed, and printed, exactly by the process already illustrated with regard to pottery. Some elegant kinds of European porcelain are reckoned as beautiful and valuable as those of the East: yet they are made on the same principles as pottery; and the two articles, indeed, may with propriety be regarded as species of the same manufacture, differing in elegance and in estimation according to the coarseness of the materials of which they are respectively constructed. For this reason we did not, under the head Porcelain, give an account of the manner in which that commodity is made in Europe, but referred our readers to the present article for suitable information on the subject.

Mr. Wedgewood.

We need not mention here, that the most elegant and perfect pottery and porcelain yet made in this country were manufactured by Mr. Wedgewood, and his sons who succeeded him. The most celebrated, probably, of all his productions, were his imitations of jasper, which were manufactured into vases, medallions, and other ornamental forms, and which soon found their way into the collections of the curious in every quarter of Europe. He also made some cameos of exquisite workmanship; the most famous of which was that of a slave in chains, in the attitude of supplication for liberty, with the motto inscribed underneath, *Am I not a man and a brother?* Of this he distributed many hundreds, to excite the humane to assist in the abolition of the slave trade. We cannot, however, at present give any account of the inventions of this celebrated manufacturer, but defer our observations on this head till we come to give an account of his life. See the articles Porcelain and Wedgewood, *Josias*, and the works there referred to. (&)

POULTRY. See Hatching, Vol. X. p. 656; and Ornithology, Vol. XVI. p. 112.

POUSSIN, Nicholas, a distinguished French painter, was born at Midelle, in Normandy, in the year 1594. He acquired the rudiments of the art under Ferdinand Elle, a Flemish portrait painter; but he improved himself rapidly by copying prints after Raphael and Julio Romano, which were lent to him by his friends. At the age of eighteen he quitted his father's roof, for the purpose of acquiring information; but he was obliged to return by ill health. On his recovery he set off for Rome, but some untoward accident again compelled him to return, when he had reached Florence. During his stay in France he became acquainted with Marino the poet, in whose house he resided for some time. In 1624, Poussin at last accomplished his desire of visiting Rome. On his arrival at the capital he found his friend Marino in a state of bad health, which at last proved fatal; but, previously to that distressing event, the poet had introduced Poussin to Cardinal Barberini, the nephew of Pope Urban VIII. from whose patronage he had reason to expect the greatest advantages. The cardinal, however, was dispatched on a legation from the Pope, and Poussin was left at Rome without any decided patron. This event compelled him to dispose of his pictures at a very low price; and he is said to have sold his battle pieces at the price of seven crowns each, and a picture of a prophet for eight livres. The ardour of Poussin to improve himself in his profession was not damped by those unfavourable circumstances. He copied several of the pictures of Titian, Dominichino, and Raphael; and, under the roof of Il Fiamingo, the sculptor, he studied with assiduity the fine specimens of ancient sculpture which Rome then possessed.

When the Cardinal Barberini returned to Rome, the talents of Poussin were brought immediately into notice. The cardinal employed him to a great extent, and paid him liberally for his pictures; and, in a short time, his talents became known in France, not only by fame, but by many of his Italian pictures. The king of France, Louis XIII. was thus induced to write him a letter, requesting him to return to his native country; and, after considerable hesitation, Poussin complied with the request, and arrived in France in 1640.

Poussin rose rapidly in the estimation of the French court, and was immediately employed by the patrons of the arts. His success, however, was attended, as usual, by the envy of inferior artists, and Vouet and Mercier persecuted him by their criticisms and their intrigues. Disgusted with these proceedings, he requested permission to return to Rome, where he arrived in November, 1642. In this capital he spent the remainder of his days, prosecuting his art with assiduity and success. He died at Rome in the year 1665, in the seventy-second year of his age.

Poussin painted for Prince Justiniani a historical picture, representing Herod's cruelty; and he spent several years on the celebrated pictures of the seven sacraments of the Romish church. His death of Germanicus has been greatly admired. He never went beyond easel pieces, for which he had a constant demand; and he was in the habit of fixing the price which he expected on the back of the canvas. A life of Poussin has recently been published by Maria Graham. See Painting Vol. XVI. p. 248.

POUSSIN, Gaspar, whose real name was Dughet, was the brother-in-law of Nicholas Poussin, who was married to his sister. He was born at Paris in 1600. He went to Rome to visit Madame Poussin, his sister, and was at first employed in preparing the pallet, pencils, and colours, for Nicholas, who, in return, instructed him in the principles of the art. His reputation as a painter gradually increased, and he rose to be one of the best painters of landscape that ever appeared. At Rome he dropped his own name, and took that of his brother-in-law. He died in 1662, in the sixty-second year of his age.

POZZUOLO, formerly Puteoli, a town of Naples, in the province of Lavora, and about six miles distant from Naples. It is agreeably situated on a point projecting into the sea, in the centre of the Bay of Pozzuolo. In the square of the town is a beautiful marble pedestal, covered with basso relievos, representing the fourteen cities of Asia Minor destroyed by an earthquake, and rebuilt by Tiberius. It supported a statue of that emperor erected by these cities. The remains of the temple of Jupiter Serapis stand in the precincts of the town. It is nearly square, and is about 130 feet long, and a little less in breadth. Three of the four columns and the portico are standing. They are of marble, and its roof is supported by sixteen pillars. Several fine statues, and fragments of capitals and cornices, have been found among the rubbish around it.

The remains of the mole form one of the most striking monuments of the ancient city. Several piles of the mole still stand unbroken, but they are sunk in deep water. The cathedral church was built from the temple of Jupiter, in the highest part of the city, and was constructed of large blocks of marble. It was of the Corinthian order. The town contains two parish churches, eight convents, and about 1000 inhabitants.

PRACTICE, is the name given to an arithmetical operation, by which questions in the rule of proportion are solved by means of aliquot parts. The general rule is, to multiply the highest denominations of the given quantities together, and then to take the aliquot parts for the lower. The sum of the aliquot parts will be the answer.

Ex. Let it be required to find the price of 840 yards of linen, at 3s. 5d. per yard. We have

840 yards at 3/5 per yard.

£840 will be the price of 840 yards, at 20s. per yard.

2/6 = $\frac{1}{8}$ of £1 . .	£105	0	0	
/10 = $\frac{1}{3}$ of 2/6 . . .	35	0	0	
/1 = $\frac{1}{10}$ of /10 . . .	3	10	0	
3/5	£148	10	0	Ans.

In like mannner may all similar questions be resolved. See Thomson's *Treatise on Arithmetic*, p. 139, for a very useful explanation of these operations.

PRAGUE, the capital of Bohemia, is situated nearly in the centre of the kingdom, on the right and left bank of the river Moldau. The city consists of the old town, stretching in an oblong form along the bank of the river; the new town, separated from the river by the old town; and the detached quarter of Hradschin, on the left bank of the Moldau. The old town, which is the largest, contains the quarter of the Jews. The new town has the best streets; and Hradschin, occupying a high hill at some distance from the river, commands very fine views. It contains the cathedral and the archiepiscopal palace, besides many houses belonging to the nobility and gentry. The Lesser Town, as it is called, which is said to be the oldest part of it, lies to the north and east of Hradschin; and the suburb of Smichow lies on the side of the river. The houses are in general of stone. Some of the buildings erected since the bombardment of 1757 are modern, but the greater number are in the old style. The whole city is encircled with a moat, or mound of earth, which is nearly ten miles in circumference. The ancient palace of Prague stood at the south side of the city, within the citadel, which has an arsenal, and is well fortified. Another large edifice, which bears the name of a palace, is situated at the other end of the town. It has 150 rooms, which are appropriated for public offices, and a hall nearly equal to that of Westminster.

The dome, or cathedral, is a fine old Gothic structure, which stands on a steep declivity of the Hradschin, and contains the rich monument of St. Nepomene, the guardian saint of the city, and the chapel of St. Winceslaus. Among the numerous churches in Prague may be mentioned that of St. Winceslaus, the most ancient, of St. James, and that of Tien, which contains the monument of Tycho Brahe. Among the other public buildings are the Hotel de Ville; the bridge over the Moldau, which, according to some, is 1850 feet long, and according to others only 742; the palace of the archbishop; that of the Grand Duke of Tuscany; that of Prince Schwartzenberg, which resembles in its magnitude and ancient style those of the fifteenth and sixteenth centuries in Italy; the palace of the Count Czernin, (formerly the site of Tycho Brahe's observatory,) and various others of the nobility. There is also here a theatre, a fine fountain in the old town, the house of Schaubitzer, the royal baths, the buildings of the university, the ruins and antiquities of the chateau of Wischehrade, and the cavern of St. Procopius about a league from the city.

The university of Prague dates from the year 1348. At one time the students are said to have amounted to 30,000, but they now scarcely amount to 900. There are forty professors. The library contains above 100,000 volumes, and a MS. of Pliny. The observatory contains a few vestiges of Tycho Brahe. The university has also a cabinet of curiosities and of machines, and a collection of natural history. There are various private collections and cabinets of medals in the city. There is here a Royal Society of Sciences, a Patriotic Society for the Arts, a Society of Agriculture, an institution for training schoolmasters, three gymnasia, and an Academy for Drawing and Painting. Among the charitable institutions there are three hospitals, two orphan-houses, and a lying-in hospital. The principal manufactures of Prague are those of linen, woollen, cotton, silk, hats, gloves, lace, woollen stockings, paper, and the ordinary articles which every large town supplies.

The environs of Prague are ornamented with numerous gardens and public walks, among which are the grand promenade, the gardens of Bucquoi, of the Count de Cunal, of Colonel Wimmer, of the Count de Waldstein, the Count de Clumm, the *Farber Isle*, and the Isles of Great and Little Venice. The monument erected by Joseph II. to Marshal Schwerin, in a village about a league from Prague, deserves to be mentioned. It occupies the spot on which he fell at the head of his grenadiers, in the battle of 1757. Population of Prague about 85,000, of whom nearly 8000 are Jews. East Long. of observatory 14° 25′ 15″, North Lat. 50° 5′ 19″. See the article BOHEMIA, Vol. III. p. 632.

PRAXITELES. See SCULPTURE.

PRECEDENCY. See HERALDRY, Vol. X. p. 736, 737.

PRECESSION OF THE EQUINOXES. See ASTRONOMY, Vol. II. p. 664, 712, 713.

PREDESTINATION. See CALVINISM, Vol. V. p. 277.

PREJUDICES.* The name of prejudice is applicable to all the opinions which we form before reason can discuss, or judgment confirm them, and to all the motives which, without due examination, are the foundations of these opinions. Prejudices may, therefore, be either favourable or unfavourable: they may second a good resolution, or subvert our best principles and tendencies; and we ought no more to reject them with contempt, than to submit to them with confidence.

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* The Editor has been indebted for this article to M. SIMONDE DE SISMONDI.

Judgment ought to remain independent of prejudice: it ought neither to resist it, nor to substitute it in the place of reflection; but to appreciate it according to its real and intrinsic merits. No opinion can be regarded as sufficiently enlightened, till all the prejudices connected with it have been analysed, till they have been traced to their origin, and estimated by their just value.

Man comes into the world, destined to a considerably long existence, with faculties and intellectual energies, though great, yet scarcely adequate to the part he is called upon to perform. He knows nothing, and he wishes to know every thing: he is acquainted only with a small portion of the great chain of being; he wishes to understand the whole system, and every minute department of it. His own experience is not sufficient to furnish him with the knowledge necessary to regulate his conduct. He is obliged therefore to adopt, upon the faith of others, the greater part of those principles by which his life must be directed. If he were not informed by those who have lived before him, what the comfort of the body, and what propriety required, he could not, without experience, regard it as necessary to clothe himself, to defend himself from cold, or to satisfy the demands of thirst or of hunger. The Deity, however, in creating him a social being, gave him a claim on the great mass of human knowledge which has been the result of the experience and observation of preceding generations. He imitates before he reasons; and imitation is nothing else but the appropriation of the knowledge of the ages that are past. His physical faculties are developed in infancy, according to the example of those who have preceded him in life; at that age, also, his moral principles are implanted and cultivated by those whose experience in the world is greater than his own; and when he attains to the age of manhood, he seems to be possessed of great knowledge and enlightened views, yet these cannot be regarded as exclusively his own, but as handed down to him by the generations who are no more.

The child who learns of his parents to love them, to clothe itself, to walk, to speak, to preserve itself from danger, is taught by them also, not only to think, and to judge, but to express thoughts which are not his own, and to form opinions which he has not capacity to examine. This uniform appropriation of the sentiments of others, is necessary, and is inseparable from his situation in the world. Called upon continually to act and to decide before he has time or ability to form his own judgment, he is obliged to adopt principles, both moral and political, on the authority of others. His opinions also on subjects of history, geography, astronomy, physics, natural history, navigation, commerce, are not the result of his own observation and research, but are founded on the research and observation of others. In youth, in short, all our thoughts and actions are founded on prejudice, to which we are entirely subject till reason and judgment begin to be developed. In proportion, however, as these are matured, we analyze, one after the other, the opinions which we previously embraced and were actuated by, and appreciate them by their own intrinsic excellence, as much, indeed, as it is possible for us to do so, while all the points of comparison, of which we are capable, and while all the notions on which we form our matured judgments, altogether or chiefly result from prejudice, and are founded upon it.

The knowledge which we obtain from others, we may be said to *believe*, but we *know* what we have ascertained from our own observation and experience, or from our own research. To the knowledge which, being received from others, we are said to believe, the term prejudice is evidently and directly applicable, till, upon every point of our belief, we entertain that philosophical doubt and distrust which precedes and uniformly produces examination; a step, without which it is impossible for our prejudices to be superseded by judgment or confirmed by it. Nor is this step to be neglected because it is found to be difficult and tedious, even to minds of the most vigorous and penetrating character. It is indispensibly necessary; for of the opinions generally admitted, and on which we place the utmost confidence, not a few, after this examination, are found to be entirely groundless; and the influence of those which we have not subjected to this test, remains, till the end of life, infinitely greater than of those which have been most assiduously examined and analyzed. Every man, therefore, if he has not adopted the step in question, whatever be the energy of his mind or the uprightness of his thoughts, is continually under the influence of prejudice, because his principles have not been established on the basis of his own reason and judgment.

Not only are our general and miscellaneous opinions either the result of prejudice, or are much modified by it, but, as previously hinted, many even of our philosophical principles can be traced to the same origin; and therefore the examination which we have been recommending, is necessary to ascertain the bias, which, on this important subject, may have insinuated itself into our views, or the views of our predecessors. In philosophy, however, we must take many of our sentiments on the authority of others; but we should endeavour, by our own research and examination, to determine the degree of influence which any opinion, not radically our own, should exercise upon our minds; and having made this distinction, we will not place a blind confidence in any hypotheses, however plausible, which are handed down to us by previous enquirers, but regard them as doubtful, and liable to be superseded by more extensive experience and more ingenious scrutiny, though in their place we cannot, in the mean time, produce any thing more solid and satisfactory.

Prejudice is liable to be confounded with presumption, with which, indeed, it is nearly connected. Presumption is that by which, when proof is defective, we draw inferences and form conclusions, and which, in the business of life, or in the speculations of philosophy, determines us in the choice of opinions supported only by probability, and devoid of the certainty of actual demonstration. But these two principles, though analogous, are not the same. Presumption is extrinsic, and the result of examination: prejudice is antecedent to it, and originates in the dispositions of our own mind; or, in other words, we apply the term presumption to the predominating shades of probability which spring from a question we have been examining, or from the accessory circumstances; whilst the word prejudice is used to denote all the predispositions to believe or not to believe, by which we are actuated prior to examination, and which take their rise in the peculiar habits and character of the mind. Presumptions, therefore, are from without, and are as various as the circumstances from which they spring; and though it is not a difficult task to appreciate and analyze them, it is totally impossible to arrange or classify them. But prejudices are within us; and though we are unable to foresee the thousand different forms they may assume with different individuals, or at different periods of the life of the same individual, yet they can be easily reduced to a pretty accurate classification according to the natural sentiments and feelings to which they are allied, or from which they result. Nor is this analysis of the origin of prejudice merely an object of curiosity. Showing us the manner in which prejudices are imbibed, it is calculated, in a very powerful manner, both to make us view with greater indulgence the opinions of others, however ill founded, and to render our own more accurate and just. We are thus led to see the most absurd belief in the most favourable light, and to check and obviate that secret propensity which we feel in ourselves, and which indeed is almost universally felt, of forming premature conclusions on subjects, the true nature and leaning of which cannot be correctly ascertained, but by careful investigation and scrutiny.

Tradition, in short, (and this term we apply to all the mass of knowledge we receive from others,) presents us only with presumptions, and it is our own minds that transform them into prejudice. Analogous principles having distinguished the generations of men who have existed before us, presumptions have in all ages been converted into prejudices in a similar manner. It is the principles from which this results, which usurp the place of judgment, and which form, as it were, the prism which colours to us every object, that we mean to analyse and illustrate in this treatise. Judgment, memory, imagination, and sensibility, are faculties or states of the mind, with which all are acquainted. This division we propose to follow, in order to show how the mind, by means of one or other of these faculties, mould or qualify the various subjects which are submitted to it, or, in other words, how the last three usurp the place of judgment, and put each its own peculiar prejudices in the room of the decision of the first. But in addition to these active faculties, there is another state of mind, which from its being passive, we shall denominate mental indolence, and which resists, as it were, the energy of the others. These faculties, then, form the division of prejudices; and in the subsequent part of this article we shall consider them in succession,—memory, imagination, sensibility, and mental indolence.

1. *The Prejudices of Memory.*

Memory, though it is not in other respects the most important or the most beneficial of our faculties, is that which gives birth to the most powerful and the most numerous class of our prejudices, and of which the influence is the deepest and most permanent on our opinions and our affections. Life, when new, was to all of us a season of joy and delight; our increasing vigour of body removed from us every want and every anxiety; hope supplied the place of reality; even our sufferings were blended with emotions so lively and so elastic, with a sensibility so active, with an imagination so fertile, that the remembrance of it is to the latest period of existence cherished with peculiar fondness. Even its illusions, its troubles, and its defects, memory dwells upon with melancholy satisfaction, and arrays them in colours of the most interesting and fascinating kind. In our more advanced years, the innocence and the charms by which our youth was characterized, cannot be felt, and are deeply regretted. We discover our sensibility to be blunted, our imagination to be extinguished, our confidence and buoyancy of spirit to be fled,—and our matured reason and judgment, with all their dignity and advantages, cannot supply to us the want of what age has deprived us. And this change, which is so painful to us, we are induced to impute, not so much to any aberration in our own mind and circumstances, as to the degeneracy of the age in which we live. We like to cherish the belief, however illusory, that there was something of reality in the scenes and the sentiments, of which, though long passed, we retain so lively a remembrance. We attribute to an alteration in the circumstances of the world, or of others, and not to any in our own, that distrust, and that jealousy, by which we are now distinguished. The kings, the magistrates, the priests of our youth, never, we flatter ourselves, abused their power, because we never suspected them of any abuse. Parents and masters had no other interests but those of their dependants and children, because our obedience and dutifulness were submissive and unsuspecting. The character of those who died, ere we attained to the age of manhood, was pure,—because their failings or their crimes were unknown to us. These dreams of age, however,—this love of the days that are past,—this respect for the character of those individuals whom we knew in our early years, are the consequences (often amiable, but always fallacious,) of that reverence which we pay to the objects of memory, and of that love which, at every subsequent period of life, we cherish for the emotions and susceptibilities of youth.

Of all the public institutions, which form the basis and safe-guard of human society, there is none, the permanence and stability of which are not owing in a great degree, if not entirely, to the feeling which we are contemplating, namely, the great reverence and respect we maintain for the remembrances of youth. A striking proof of this may be traced in that indescribable popular affection shown to all established reigning families, though they are the depositories of a power, which, from its very nature, is more frequently employed to punish than to reward. Though they are the objects of the most devoted atttachment, it is in *their* name, and by *their* authority, that taxes are raised, restrictions and prohibitions imposed, war and the levying of soldiers take place, punishment and torture of every kind inflicted; whilst the good which they do, and the benefits they confer on society, are entirely of a metaphysical nature, and incapable of being appreciated by the great mass of the people. They maintain order and afford protection, neither of which we feel, or which seem to result not from them, but from ourselves. Their most beneficial influence resembles the air which we breathe: it is essential to our very existence, a fact of which we either are not aware, or which we entirely overlook. A few individuals, indeed, are known to the sovereign, whom all love and obey; they obtain personal favours, and are elevated to places of honour and distinction; but the great body of the people have no other connexion with the government than by the taxes they pay, and the privations they undergo to support it. Every class of the community, however—the soldier, the peasant, the artisan—uniformly speak of the prince who rules over them, in terms of the warmest tenderness and the blindest confidence, of which prejudice alone tells them he is deserving. "He is our good king," they say, "our beloved monarch: if he do evil, it is because he has been deceived, because he cannot be expected to know and see every thing, and because he is surrounded by perfidious ministers." Never do the people attribute to their king individually, crimes, narrow mindedness, or error.

What then is the tie which binds the people to their sovereign? They do not respect him on account of his own individual merits or excellencies, nor on account of the advantages they suppose themselves to derive from the form of government of which he is the head. These advantages they cannot ascertain or discriminate; and of his personal merits they have no opportunity of judging for themselves. But they love and reverence their prince, as the representative of times that are past, as inseparably connected with the remembrances of their youth, as the depository of that blind confidence which, in their early years, they were so eager to grant. He is the king under whom their fathers lived; and this idea recals the time when they were blest with parents, the object of their first affections, whose happiness was so intimately entwined in theirs, and who did all in their power to render their life agreeable and delightful. The same sovereign now reigns; or his son or his grandson occupies his place; and the same system of government now obtains which existed in the good old times, which they believe free from every abuse, because abuses did not come within the scope of their observation. The historian, in his researches into the events of past ages, is not unfrequently surprised to find that kings, distinguished by crimes of the basest kind, and by the grossest abuse of power, have yet been the objects of the love and the confidence of their subjects. In vain has he endeavoured to trace the cause of this apparent contrariety. The principle which we are discussing explains it in the only satisfactory manner. It is not the king, individually, that they love,—it is the time past, the period of their youth.

The respect which we entertain for ancient families, for ancient authorities, for ancient laws, for an ancient constitution, results from the same principle. Time is the great enemy of our race, and whatever has triumphed over time, becomes dear to us on that very account. But, in truth, we do not admire or value a thing solely and entirely because it is old, but because it reminds us of our childhood and our youth; for, by a singular association, the two ideas are in our minds closely and indissolubly united. Time past, abstractedly, would not excite our reverence or interest very powerfully, if it did not bring along with it the remembrance of our boyhood, and carry us back to that period when no care and no sorrow was felt, and all was health, enjoyment, and hope.

Every system of religion, even the most wild and absurd, owes its stability and its influence to similar feelings and principles, and appeals to them as an indubitable mark of its celestial origin. That innate respect for the doctrines of any religious creed, which reappears in the case of those, who having apparently thrown off for ever the belief of their fathers, yet, after a long interval, return to it with renewed attachment and devotedness; that slow conversion of those who have been long distinguished for incredulity, and an inordinate attachment to the object of sense; that faith which triumphs over doubt, after doubt had for a long time sapped the foundation of faith; that return of the Jew to his tabernacle, of the Mussulman to his mosque, of the Bonse to his pagod, after having been for a while the victims of infidelity; that excess of joy felt by the people when Julian re-established the observance of these ancient superstitions, which seemed to be for ever superseded by the progress of more salutary and more rational doctrines,—these facts, and a thousand similar, are daily appealed to by every theological system, as a proof of its respective dignity, influence, and divine origin. But it is evident that an argument, of which every religion, however erroneous or degrading, may avail itself, ought to be regarded as conclusive for none; and, in truth, it proves nothing else but the powers and the charms of memory, particularly the memory which recals to us the sentiments and the sympathies of our youth.

Every parent, whatever be the theological creed which he has embraced, regards it as a duty to give to his children what is called a religious education, that is, to teach them the doctrines in which he was himself educated—to strike their imagination with its wonders—to impress on their tender and pliant hearts reverence and love for its majesty and purity—and to remove the fear of ignorance by its protection and its consolations. All the poetical faculties of youth, which are then so brilliant and so susceptible, but which gradually disappear as we advance to the stern age of manhood or of decline, are early associated with the national religion, of whatever character that may happen to be. If the parents have themselves conceived doubts, they carefully conceal these from their children, and wish to transmit to them, pure and unsullied, the faith in which they have ceased to put implicit confidence. If this faith is contrary to the light of natural reason, or to the principal foundations of morality; and if, in such circumstances, a man feels inclined to exercise his own judgment on the subject—to compare his belief with that of former ages—and to entertain doubts of what they believed demonstrably true, the edifice of his religion is demolished before his eyes, often before he can have time to construct or embrace another in place of it; all his principles are shaken; he floats in uncertainty; distrust and scepticism is extended to every object and sentiment; he regrets the happy time when all was confidence and belief, and when all the distress of doubt and uncertainty were unknown and unheard of. In this disagreeable state of scepticism, few are doomed to continue till the termination of their days. When old age, with its feebleness and its terrors, overtakes a man situated as we have described, the faith of his youth, the faith of his fathers, rush upon his mind with double force; he regards it as celestial and divine, and unspeakably endeared to him by the remembrances of his childhood. It recals all the hopes which he had once so fondly cherished; it re-awakens that love which was once so strong, but which the withering hand of age had now extinguished, and it revives those dreams of the imagination which either had entirely ceased or lost their power to please. He now wishes to believe what he had so long doubted, because, in believing, he seems as if he were beginning life anew; and he at length ends his days under the influence of that faith which he had received from his fathers.

The remembrances of our early years afford a prejudice favourable to the state of things as they then existed, whether it be good or evil. This prejudice exercises a most powerful influence on the social and political circumstances of nations, as it, in almost every case, holds out a guarantee for the permanence and stability of institutions, whatever be their nature, with which we have been connected from our youth. It serves as a check to the spirit of innovation, or to the popular inquietude which distress, or the insinuations of factious men may occasion. On the same principle, reform is very slowly effected, and revolutions seldom occur; for, except in time of great suffering, or the most galling oppression, the power of memory has much deeper influence on the popular mind than the desire for reform, or the taste for change. There are, undoubtedly, various other causes which lead men to maintain and adhere to existing institutions; but that which we are discussing, is not only the most powerful; but is the last from which we can shake ourselves free.

There is, however, one case in which the remembrances of youth, and the prejudices which result from them, have a tendency to overturn established order, and, unless that order be very old, to foment revolutions. This takes place when the organization of a nation, whether civil or religious, has been already completely changed by a revolution. It is one of the attributes of memory to efface the evil, and to magnify the good, by which former days were characterised; because, as previously mentioned, memory uniformly associates the remembrance of past time with ourselves, with our own youth, when all was gaiety, enjoyment, and hope. Unhackneyed in the ways and the wiles of the world, regarding life as an uninterrupted series of enjoyments, we then placed unbounded confidence in others and in ourselves, and esteemed the order of things as then known to us, as the most happy and perfect. But when, from any cause, a revolution has changed the regime under which we began life, we may at first not regret the change; but, ere many years elapse, we look back with fond and longing regards to the order of things that obtained in our youth, and which we would reckon no sacrifice too dear to recal and to re-establish. If reform supersede the Catholic faith, the old man regrets the pomp and brilliancy of the church which, in his youth, he had embraced and reverenced,—the magic of its mysteries, and that unshaken confidence in its tenets which it cherishes, and which, in prohibiting examination, at the same time prevented doubt. If a warlike and enterprising usurper succeed to a long series of pacific and unambitious kings, the old man regrets the times of peace and ignorance, when a profound silence covered every corruption, and when, as his ears were never troubled with any complaint, he did not believe the existence of abuse. If the reverse of this takes place, and if the legitimate sovereign begin to sleep on his throne, instead of exhibiting the energy and the bravery which distinguished his predecessors, the nation looks back with lingering fondness to the glory of the times that are past, and they forget all the sacrifices and the blood by which it was acquired. This constant disproportion between the remembrance of former days, and the value set on present time,—this universal prejudice in favour of the regime which we have lost, is one of the great causes of that long vacillancy which always follows political and religious revolutions, and of those daring efforts, often successful, which are made to re-establish that order of things which seemed to be for ever gone, and its abettors either destroyed or awed into submission. For the truth of this opinion, we may appeal to the history of all nations, from the conspiracy of the sons of Brutus in favour of Tarquin, till the present day.

II. *The Prejudices of the Imagination.*

Every one of our faculties is distinguished by its own peculiar prejudices, on account of the exertion we make to render these faculties as active and as powerful as possible. Every faculty also extends its empire into the provinces of the neighbouring faculties, and usurps the place, or diminishes the influence of reason. Memory is opposed to innovation and change; and in proportion to the power it exercises over us, we give the subjects of it the superiority over those of our own observation and experience. The efforts of the imagination, which we are about to discuss, are of an analogous nature; and the more we indulge them, the more are we attracted by the love of the marvellous and the ideal, and the more do we substitute illusion for what is known and real. The love of the marvellous, indeed, is the second great source of our prejudices, because it proceeds from the second of our faculties, which is found to exist in a greater or less degree in every individual.

Our judgments are the work of reason alone; but reason is not the most powerful of the faculties: it is not, at least, the one from which we derive the greatest pleasure and enjoyment. The imagination is developed earlier than reason; it is from its nature more popular; it is communicated more easily to the great body of mankind; and it unusually soon forms a tie and a connexion between individuals otherwise dissimilar. A creative imagination is indeed rare; a contemplative imagination, that which revels, without fatigue, with fancies and images presented to it, is almost universal. The marvellous is the province in which the imagination delights to roam; the belief in well-authenticated facts affords little or no pleasure to the mind: but whatever astonishes, whatever enlarges the habitual sphere of our ideas, whatever removes the boundaries of the universe, in which our faculties seem as it were imprisoned, is the source of unspeakable delight. Imagination revolts at bare possibility; it ranges beyond the barriers of the understanding with the same joy as a bird when escaped from its cage; and the motive for indulging and believing the speculations which it conjures up, is merely that they are incredible.

The wonderful is sometimes presented to us by the poets and the writers of romances, simply as the play and liveliness of the imagination. In such a case we surrender ourselves to it without scruple, since it does not require of us the sacrifice of our reason. But the pleasure we derive from it is not complete, because it demands not the exercise of any extraordinary degree of credulity, and because it is not sufficiently elevated above the probability of common occurrences. We are disappointed with a work which has nothing new, not because it has deceived us, but because it has not deceived us enough.

The marvellous is also presented to us in popular recitals and traditions, which our reason cannot admit or recognise, but which, from their number, the concordance of their circumstances, and from their result, seem not to be devoid of a certain degree of authenticity. In whatever state of society we are placed, whether the people among whom we live be ignorant or enlightened, we hear stories of apparitions, of prophetical dreams, of visions, and a thousand others similar. By observing attentively, we may see with what uncommon care the narrator avoids or suppresses every circumstance which could give to the facts related a natural explanation, and yet with what secret satisfaction every one of the hearers, after protesting that he does not believe in spirits, in dreams, or magic, declares that the facts are singular, very singular, and altogether inexplicable. Is it not evident that every individual cherishes a lurking belief, almost unknown to himself, in the existence of fairies and supernatural beings; that, in relating an anecdote, he feels an irresistible tendency to introduce and appeal to supernatural agency; that he fortifies his own opinion by the hope that others will add their testimony to his; and thus, at last, prejudice inclines him to admit the truth and reality of what he does not wish or is not able to refute?

Many instances of the marvellous are also presented to us in real life, and in the natural order of events. The passions and emotions by which we allow ourselves to be actuated in contemplating events which take place around us is not one of the least causes of our errors and our sufferings. The romantic life of a hero and adventurer, as it is invested with greater uncertainty and greater privations, gains our esteem and admiration in preference to the mild virtues and the discriminating wisdom of the most illustrious statesman or legislator. The misfortunes of Mary, Queen of Scots, and of her descendant, Prince Charles Edward, commanded the sympathy, the love, and enthusiasm of millions. In the cause of these princes, how many have joyfully sacrificed life, though neither of them was worthy or capable of reigning! How many labour still to blot out every stain from their memory! And yet every individual, in the circle of his own private friends and acquaintances, can undoubtedly find many persons more distinguished for virtue, for good principles, for integrity of character, than the prince for whom he is willing to lay down his life: but a friend, a private man, is invested with none of those attributes, always dazzling but often false, which are calculated to strike the imagination. Supreme, uncontrollable power attributed to a man, partakes of the wonderful in no mean degree; and is, perhaps, one of the great reasons of the adoration of the people to their king. Those whom we, or our fathers, have elevated to a throne, we regard almost as gods; and we prostrate ourselves before the idol formed by our own hands. But a fugitive king, a royal prisoner dragged to punishment, is a deity in distress: the marvellous is here carried to the highest extent of which reality is susceptible; this is the most overwhelming source of enthusiasm; and we are all attachment, admiration, and sympathy.

Of all human events, that which is most inseparably allied to the marvellous is war; which, in every nation, and every stage of society, is the source of the strongest prejudices. Hence our admiration for the talent which is the most fatal to our race, our joy when we hear of defeat and victory; and hence that enthusiasm which excites in us a thirst for military glory. This prejudice arises from the weakness and inefficiency of our bodily powers, compared with the ardour and energy by which our mental faculties are distinguished. It is because we feel ourselves weak that the display of strength commands our praise and affections, and the achievements of one man seem to afford a compensation for the general feebleness of our race. The general who has ranged a hundred thousand men under his command, and who has rendered them as obedient to his word as the members of his body are to his thought, appears to the imagination as something more than human. And the greater difficulties he has to encounter, the more fierce the enemy that opposes him, the more are we astonished, and the more his triumph delights us. His courage and enterprise also seem to us striking and admirable, in proportion as we are ourselves distinguished by timidity. Accordingly, the enthusiasm of females for the warlike character is incomparably higher than that of the opposite sex. Without this admiration, so emphatically and so cordially bestowed, the names, comparatively speaking, of few of those whom we justly denominate heroes, would now have been encircled with military glory.

The marvellous, in fine, is carried to its highest extent in religious belief. As almost every religious system, whether pagan or inspired, has for its object things which reason can neither analyze nor conceive, there is an apparent cause for excluding reason entirely from the contemplation of such high subjects. But a careful distinction should be drawn between what reason cannot really penetrate, and what is palpably absurd and unfounded, and cannot in truth exist. In not a few of theological systems, belief comprehends not only what, from its very nature, is too high for the human understanding, but what is contrary to it. And priests, who are the authors of this corruption, and who find it an inexhaustible source of power and wealth, have too much interest in continuing the delusion not to resist every examination of their discoveries, and to enforce faith at the expence of reason. This blind submission, which is diametrically opposed to the doctrine of the reformed religion, and to that appeal made to all men to examine their faith, which constitutes reform, seems to have been revived by the reformed churches themselves, so soon as they were established,—so soon as they no longer formed an opposition in the bosom of another church, a minority called upon to attack or defend themselves by reason and argument, the only weapons by which men can be effectually and permanently convinced. Wickliffe, Luther, Calvin, Zwingle, appealed from faith to reason and examination, from prejudice to judgment; and the exercise of our faculties which they recommended, has conferred upon us the advantages which we now enjoy. But the candour which characterized the early reformers has in a great degree disappeared; our doctrine is still that of the reformed church, but our language does not correspond with our doctrines. A certain degree of the wonderful, a certain degree of blind superstitious belief, the submission of reason to faith, constitute a prejudice so essentially interwoven with the nature of the human mind, that no small proportion of the reformed churches have adopted and enforced principles which have rendered reform an empty name, and which are as absurd and as little supported by Scripture as any of the dogmas which reform has superseded. They behold with ill-will and displeasure the exercise of reason in investigating the truth of doctrines which they wish to be implicitly adopted and believed, and they regard, as the first of virtues, that disposition which, in prohibiting doubt, renders examination, and afterwards rational conviction impossible.

The eagerness we have to believe,—the thirst we possess for the marvellous, is still more decidedly manifested in the successive adoption of opinions which are common to every religious system. The more any particular dogma is repugnant to sense, to reason, and to all the means we have of knowing truth, it is adopted with the greater zeal, and maintained with the keener animosity. Words susceptible of two interpretations, the one according to reason, the other contrary to it, have uniformly been taken in their mysterious sense, because this meaning required a great sacrifice of the understanding. Figurative and poetical expressions have, on this principle, been interpreted in their literal sense, even contrary to the evidence of the text in which they occur. The history of heresies, which presents to us doctrines founded, not on the word of God, but on the fancies and dogmas of men, proves to us that opinions which are the most wild and extraordinary, are preferred to those supported by reason, by Scripture, or by nature. The belief in transubstantiation may serve as an example of this tendency in the human mind to select the most absurd and incredible inferences from words susceptible of a simple and rational explanation; and upon the same principle, opinions of the most important kind are not unfrequently founded on expressions, which to an unprejudiced mind would convey no such ideas, and which, from the different shades of meaning in which they might be used, would be insufficient to establish the authenticity of a single historical fact.

Testimony, of whatever kind, is modified in a greater or less degree by our love of the marvellous. A man, whose prejudices are strong, and who wishes to give poignancy and effect to what he relates, does not know, or does not reflect, that he is distorting and qualifying the truth. He thus, without apparently intending it, rejects circumstances which appear to him trivial, but which, notwithstanding, to other minds might have been the source of doubt or of conviction; he twists events; he assigns effects to erroneous causes; and he forms a regular and connected narrative from detached and isolated facts, incapable of themselves, without prejudice, of any such interpretation. The impression, however, which he thus wishes to make, is that which most flatters his imagination, and which is most closely allied to the marvellous. We ought not therefore to form an unfavourable opinion of the person who relates to us extraordinary facts; nor to believe that he intends to misrepresent or to deceive; but before admitting the truth of his recital, we ought to endeavour to ascertain and analyze the prejudices by which he is influenced, and the effect which they are calculated to have on his judgment and his principles. We ought to remember that these prejudices may have led him to suppose he saw things which did not exist, merely because he had a pleasure in seeing them, and that he has related events which never took place, merely because he derived a gratification in confounding his imagination with his memory. Let us not say of an ocular witness that he could not have been deceived, for probably he took delight in being deceived, and the eyes which so anxiously sought the wonderful, experienced no great difficulty in finding it. Such a person, we ought to reflect, can have no interest in deceiving us; the only interest he feels is giving way to extraordinary impressions, and making extraordinary recitals. Let us, therefore, doubt of the facts without condemning the credibility of the witness; and to the universal prejudice of the vulgar, which adopts, amplifies, and propagates whatever is wonderful, let us oppose the prejudice of the wise, which doubts and distrusts.

III. *The Prejudices of Sensibility.*

In addition to memory and imagination, sensibility may be mentioned as substituting impressions in the room of reason and judgment; or, in other words, as the source of various prejudices. A state of apathy and indifference is probably the most uninteresting, and the least happy condition in which we can be placed. Whatever, therefore, has a tendency to develope our faculties and rouse our affections, to make us, as it were, *live* more and feel more, affords us pleasure and satisfaction. We are anxiously desirous of every thing that can excite joy or sorrow, love or hatred. We are gratified to feel and to know that our heart is filled with emotions, whether these be painful or otherwise. Though these emotions be of the most opposite and heterogeneous character, they still afford us proof that our sympathy and sensations are strong, and that we are formed for feeling an interest in life,—circumstances which are the source of much satisfaction and delight. The necessity and desire, therefore, of having our emotions and sympathy excited, are the principal cause of the prejudices which sensibility rouses and developes.

All our false and erroneous opinions, however, it must not be forgotten, do not take their rise in the prejudices which we have been contemplating. Some of them have their origin in the general cast and character of our mind, without being referable to any one faculty of it; others are purely accidental, and belong to fortuitous cases, which can be ranged under no class. All our sentiments and judgments, (as circumstances, whether accidental or otherwise, call them forth,) result, therefore, from the general tendency and habits of our dispositions and intellectual endowments, though their origin cannot always be minutely and satisfactorily traced. And it is the power of memory, the love of the marvellous, the desire and necessity of emotions that modify them, and transform them into prejudices.

The taste we have for painful emotions is one of the most singular and apparently absurd of all our dispositions. We undoubtedly wish to be happy; and the pursuit of happiness is the greatest spring of action; but we are not willing to abandon our title to be miserable, or rather there are not things so contradictory which we wish not to be at one and the same time. If any one congratulate us because we enjoy the smiles of fortune, because all our tastes and all our inclinations have been gratified, we never fail to answer him that he knows not all the secret troubles, all the gnawing cares which lurk under the garb of outward prosperity. We seem to court melancholy; and in the midst of success, and of all the advantages of fortune, we nourish the canker which destroys our happiness; we cherish distaste of life, and complain of the fatigue and emptiness of all its enjoyments.

This partiality for painful emotions is not entirely affected; it is indeed often the true source of our actions, and the natural tendency of our thoughts. As we almost insensibly place our hand on the spot, which being diseased or injured, excites pain, and as we cause irritation in it by our touch, in like manner we involuntarily give way to painful reflections; we resist the torpor which would remove them from our attention, and we excite and prolong anguish which otherwise might not have been felt or would soon have disappeared. From this propensity of our mind arises a prejudice almost universal in favour of whatever produces sorrow or suffering. A recital, however unfounded, which disquiets and rouses us, is already in our estimation half proved; a fear which renders us unhappy is already half realised. The same remark is also applicable to joy, and upon the same principle; the only difference between the two is, that joy is more common, as it is more directly and steadily the object of our wishes and pursuit. And in proportion as any narrative, or the relation of any event, makes a deep impression on our mind, either of a sorrowful or joyful description, our sensibility in the same degree increases our belief; and whatever raises emotions in us, assumes at once, in our view, the appearance of probability or of truth.

It is, however, not only in grief or in joy that sensibility is called forth; it appears also in love and in hatred. Our self-love is higher when we feel ourselves to be influenced and actuated by strong emotions which we delight to cherish; and we have much greater satisfaction to have our conduct regulated by sympathy or antipathy than by reason and judgment.

It is the province of sensibility to direct our estimate of the various individuals with whom we may be connected, to form those ties which sweeten existence, to choose our friends, and to render us worthy of a return of their affection. This is indeed the proper department of sensibility; but we extend it still farther. In appreciating things, and in forming our principles of action, we are, in no inconsiderable degree, determined by it; we make morals not unfrequently an affair of sympathy or antipathy; and we prohibit the examination of what we have thus approved or condemned, as emphatically as if the decisions of sensibility were infallible, or as if there was no appeal to a higher or more unerring standard.

While we assert this, however, we do not deny the existence of what has been denominated the moral sense or moral faculty; that state of the mind which, (though it is much modified by education, or the circumstances in which we are placed,) gives us an intuitive perception of good and evil, of virtue and vice. It is not necessary, nor have we time at present, to enter upon an analysis of the nature and functions of this faculty. We shall not endeavour to ascertain whether it is an instantaneous exercise of ratiocination, so rapid that the several steps of the process escape our observation, or whether it is the result of early associations, and an impress of public opinion made on our minds, without our being in the least conscious of it; or whether the ideas which the moral faculty excites in us are really intuitive and innate, imprinted by God himself on the human heart, and ought to be acted upon and appealed to in every case of doubt and perplexity. It may be remarked, however, that those who have espoused this last opinion, have been forced to allow that the two others have also a powerful tendency to produce similar emotions; and that the line which separates the three opinions in question cannot be easily traced or defined. Besides, every innate perception should correspond with the decisions of reason; and as the suggestions of the moral sense, taken according to the first two definitions of it, do often and may always correspond with the decisions of reason, the real origin of this faculty may at any time be made the object of discussion, and will never, it is probable, be entirely ascertained and established. As the origin of this faculty, therefore, cannot be indisputably settled, it is impossible to point out the exact degree of confidence which in every case should be given to it. It may, however, be regarded as the safest rule, that while we pay the greatest deference to its suggestions, we ought also to subject them to a strict scrutiny and examination. As in the opinions we form of external objects, we rectify one of our senses by the other; as, for example, we consult the sense of touch when we suspect an error in that of sight, and when we find a contradiction between them, are assured that one or other of them has deceived us; so as often as the moral sense awakens in us emotions, whether of sympathy or of antipathy, which reason and investigation do not confirm, we may conclude that error exists somewhere; and we ought, therefore, to draw no inferences till we have brought the subject under review to a new and a more strict examination. In making this examination, we shall find either that we have made a mistake in our reasoning, or that we have implicitly adopted opinions on the authority of others, or that our moral sense is clouded and distorted by the previous circumstances of our life, or by those in which we are at present placed. We may thus arrive at the truth with as much certainty, as in the case of external objects alluded to above, we confirm or disprove the decisions of one sense by the successive exercise of the others.

Sympathy, when applied to persons and not to things, or not to the principles of moral conduct, is the source of the most amiable of our prejudices. It is sympathy that prompts us to undertake the defence and espouse the cause of whoever is in distress, or is unfortunate, or oppressed. Sympathy, too, promotes our own happiness in proportion as it contributes to the happiness and welfare of others. This feeling, however, though enlightened and apparently well directed, often misleads our judgment, and inspires us with prepossessions in favour of individuals, which investigation and experience do not justify; but it is better and more pleasant to be deceived, than to have doubted and mistrusted.

But antipathy, or the prejudice of hatred, exercises the most fatal influence on the human mind. The activity of our sensibility seems not to be satisfied if we sacrifice to it those only whom we have good reason to hate. It requires hecatombs. It embraces whole tribes and nations. Any external difference,—a difference of name, of colour, of language, is sufficient, we think, to prevent us from being candid or just; and we applaud ourselves for the energy of our hatred towards persons in such circumstances, though probably not one of them is known to us. The fault, real or supposed, of a single individual, we extend to his family, to his sect, to his countrymen; that of one age is attributed also to the succeeding ages. By such illiberal judgments we flatter ourselves we are showing our horror at vice; and we even sometimes go so far as to regard the sentiments in question the best proof of the soundness of our religious principles. In an Egyptian convent, where an English traveller lodged, the monks described to him the vexations they experienced on the part of the Turks. In these masters, who are often so oppressively cruel, every thing was a cause of offence; their opinions, their manners, their habits, their language. "Do you not hate the Turks?" said one of the monks at length to their guest. "I fear the wicked," replied he, "but I hate nobody." "You hate nobody!" exclaimed they, "then you cannot be a friend to our order."

The prejudices of hatred undoubtedly have their origin in the human heart; but they are rendered a thousand times more inveterate and strong by those who govern us, and who have an interest in cherishing and perpetuating them. Our rulers uniformly study to encourage and augment national hatred. Governments are reciprocally offended at each other; and the people, who know not each other, and never have had any mutual communication, are made to imbibe the same spirit, and become deadly enemies. The supporters of different religious sects, sometimes also, we fear, cherish no great love or liberality towards each other, and thus dishonour the name by which they are called. And yet there is any thing but a well-grounded or natural enmity between nations and between churches. How can one man be offended at another because he has a different way of honouring and worshipping God? How can sentiments which elevate us towards our creator cause us to quarrel with any of our brethren? It is not religion which is intolerant; but it is man, —who has built his power and his greatness on the credulity and prejudice of others: it is man who has cultivated religious hatred, and who has associated it intimately with a sentiment, which of itself inspires only benevolence and love. How can any nation be the natural enemy of another? Has not each in its own bosom the elements of its own felicity? If one nation wish assistance from a neighbouring country, will not that assistance be obtained more readily and efficiently from a people who are prosperous and happy, than from those who are discontented and oppressed? But the hatred of which we are speaking originates not in the collective body of a nation, but in some individual of it. He who wishes to secure for himself alone the honour and the advantages of his country's prosperity, is jealous of the subjects of another kingdom as he is of his own citizens; he excites mutual jealousy between them, and he thus directs against his neighbours that jealousy which he feared would be exercised against himself.

Our natural dispositions would never excite in us prejudices of hatred so inveterate as those we have been describing. This is effected by the low artifice of our rulers alone. They have endeavoured, and partially succeeded, in making us wish the downfal and oppression of our equals and neighbours; whilst the only thing, in which nations and individuals should take an interest and contend with each other, has not been sufficiently attended to; namely, the advancement of the dignity of human nature, of liberty and of reason. This great object is the same in every country and nation, whether allies or enemies. National hostility is merely temporary, and must have a termination; but the diffusion of knowledge, the establishment of liberty by more liberal laws, the superiority of reason over prejudices, are advantages in which the whole human race are concerned, and the effects of which are equally salutary and permanent.

IV. *The Prejudices of Mental Indolence.*

We have hitherto considered the prejudices which have their origin in, or are connected, with our faculties; but another class of prejudices spring up in us from the absence of faculties; from indolence, which may be denominated a negative power of the mind. The love of repose, timidity, and mental inactivity, are voluntary diseases, which weaken and paralyse the exercise of reason, without substituting any other faculty of the mind in its stead.

An aversion to new ideas, to change, to reform, to all, in short, that requires any great energy of mind, or that militates against the principles we had already formed, is a disposition common to all people, and its empire is great, according to the inveteracy of our prejudices, or according to the necessity under which we labour to shake off its control. Activity of mind is, we confess, a disposition natural to man; but it is a disposition which has a tendency to decay. It seems to be peculiar almost only to youth; and with by far the greater number of men it diminishes in proportion as they advance in years. Mental contention, or our original and long established principles being opposed by new ideas, is the source of great uneasiness and labour to him who has laid aside the habit of analyzing all his thoughts. The doubt that our former opinions are founded on prejudices, is the announcement of a painful and laborious investigation. It compels us to enter upon a process of examination, which requires a degree of attention which discourages us; and not unfrequently we have to retire from the task, from the humiliating conviction that we cannot perform it—that it is beyond the reach of our faculties—and that the higher regions of thought are a sphere which is now for ever denied us.

When we have submitted a great number of our prejudices to examination, and when, having thus fixed our opinions on several points, we have, as it were, erected land-marks to guide us in the vast regions of thought, doubt is by no means unpleasant or alarming. We know the firmness of the basis on which our convictions rest, and we feel a repose and a surety which ignorance or prejudice could never afford. The truth of our principles encourages and animates us; and our mind, anxious to fix its ideas, takes in successively new objects of contemplation with an ardour more and more lively. We thus are daily making conquests in the region of darkness. But by far the greater number of men have not been accustomed to reflection. They have substituted the authority of others in the place of reason. They have maintained, unaltered and uninvestigated, the opinions which they received from their instructors, and never imagined that the ideas which they thus obtained were susceptible of proof, or required it. If, in a mind thus formed, a doubt on any one point were to be started, it would be immediately overwhelmed with confusion and astonishment; every opinion would be shaken and undermined; truth and falsehood, reason and prejudice, would be indiscriminately blended together, and all would be conjecture and uncertainty.

In proportion as prejudice has made inroads upon our natural opinions, the habit and the power of reflection have been removed or annihilated; and doubt, when introduced into the mind, commits there the greatest ravages. A mind, over the faculties of which prejudice has for a considerable time exercised authority, has, from this long state of repose and inactivity, lost the very basis of reasoning; it possesses precise and defined opinions on no subject, and it is ignorant of the method of acquiring them. In a building, a single stone removed, or put out of its proper place, is sufficient to bring the whole edifice to destruction. In like manner, doubt on one point not unfrequently leads to absolute and universal incredulity. Every one must have remarked, that those in the Protestant church, who shake off the common belief, are contented with modifying it in a greater or less degree; while those who abandon the Catholic church plunge almost always into atheism. When a single point of faith is attacked, the influence of the whole system is weakened; and thus the opinions and the hopes which we were once taught to cherish are gradually undermined and destroyed.

It is not, however, in matters of faith only that doubt is the source of uneasiness. In other matters, whether of a public or private nature, the same feelings are excited: we resist with eagerness the first intimations of doubt, and endeavour to wrap ourselves up in confidence and security. This lulls us into a state of mental repose, which doubt immediately dissipates and destroys. When danger is inevitable, there are few men who at once allow themselves to see it in its true and alarming colours, and even when it may yet be removed and resisted, men not unfrequently allow themselves to remain insensible to their situations, and regard as their enemy him who gave them the first intimation of their danger. When a man has been told that his servants rob him, that his mistress betrays him, that his friends are unfaithful to him, or, in a more important case, that his public and political interests are invaded,—even when he is told all this, he listens to the intelligence with prejudice, he believes, or tries to believe, that it is unfounded, he endeavours to preserve the ease and repose of his mind, a blessing which he seems to cherish with peculiar delight. He feels displeased with the person who wishes to excite his fears, he rejects his suspicions and his intelligence, and applauds himself that he is possessed of sufficient generosity not easily to believe evil.

If we endeavour to make him suspect the mode of government under which he has lived, its legislation, its political organization, he will oppose these endeavours with the most obstinate incredulity; he will defend the system to which he has hitherto submitted with the keener inflexibility, in proportion as it has been less the object of his study and investigation, or in proportion as his attachment to it has been founded on prejudice. An invincible terror causes him to resist the destruction of all that he has known and admired from his infancy, of which his prejudices will not permit him to examine the consequences. This terror seems to be instinctive, which nature excites in us at whatever is unknown, and which is often salutary in making us shun dangers, the result of which we cannot calculate.

This dread of new experience, this repugnance to doubt and distrust, this indolence and unwillingness in exercising our faculties on subjects of speculation, to which we have been unaccustomed, are increased and fortified by personal and by national pride. We wish not to allow that we, or those whom from our infancy we have been accustomed to respect, have acted improperly, or have been actuated by bad motives. We defend an ancient system of government, upon which the will of the people have had no influence, on the same principles that we defend a dogmatical religion. There is no one point or department in it that we will consent to abandon, because, in our estimation, every part being connected with the whole is equally sacred: which is, indeed, the case when they are all equally founded on prejudice. A constitution, on the other hand, on the formation and perfection of which reason and judgment have been consulted, is not on every point equally venerated; its parts are more independent of each other, and it can admit of corrections and of changes without being entirely overthrown.

Such is undoubtedly the principal reason of the unshaken stability of these constitutions in the East, which have enchained the faculties of the human mind, and put a complete stop to the progress of improvement; and of the division of castes, which subjects a vast proportion of the population to the most hopeless and degraded state of misery and humiliation: a circumstance the more remarkable, as few or no advantages result to the higher classes from this degradation of their inferiors. We would at first sight suppose, that this violence against nature could be maintained only by force, and yet the contrary is the fact; it is maintained against a superior force, if the people, in whose hands it is, knew or chose to exert it.

The Jewish nation have been conquered by people of a different religion and of different manners, who, for centuries, have laboured to destroy their system; but, in defiance of every exertion, the oppressed classes have submitted to disabilities and contempt; they never have revolted; they have not endeavoured to shake of the yoke, even when it was imposed on them by people inferior in resources to themselves. The long duration of Judaism is one of the most astonishing triumphs of prejudice. The Jews have uniformly and inflexibly resisted examination, and the force of every argument brought to refute and counteract their opinions; and, in doing so, they have entrenched themselves behind the principles already mentioned,—the dread of new opinions, mental indolence, and national pride.

Prejudice is, by its very nature, stationary; but reason is progressive. Legislators, therefore, who wish to impart to their institutions and enactments an eternal duration, have wisely endeavoured to enlist prejudice in their favour, have founded them on the basis of that indolence of the mind which we have been discussing, have prohibited examination, and have banished reason from their dominions. They have found in prejudice a power always ready to defend existing establishments against every innovation, however salutary, both to the individuals immediately connected and to the general interests of mankind. This plan may be prudent, so far as legislators themselves are concerned, but its results are uniformly injurious to society. With an arrogance, which ill becomes man, they have set bounds to the powers of the human mind, and, in their assumed wisdom, have said, that their actions and views have attained to the standard of perfection, and have endeavoured to render improvement impossible. But precautionary prejudices will not save social institutions, either from gradual deterioration, or from calamities which may overthrow them. Countries where civilization is stationary, being always the same, are really deteriorating, when compared with those that are making regular advances in refinement and liberal knowledge. Besides, where social institutions undergo no change, the human character necessarily degenerates, because government, being fixed, neither excites interest, nor affords scope for the exercise of genius and talents; because the arts which might otherwise have flourished there gradually disappear; and because the stationary character of institutions does not defend them either against conquests, or against tyranny, or against pestilence and famine, or the numberless scourges of earth or of heaven. When this stationary system is proposed for our admiration by men who are not ignorant of a better order of things, we are tempted to ask them, if the hell of Dante would not appear preferable in their eyes to what they propose, since they would possess a more certain guarantee of its immutability.

It is not among the Indians only, where social and political institutions are stationary. All the eastern nations reject, with an almost equal degree of horror, every idea of change, though the actual order under which they live is for them a state of suffering, of oppression, and of ruin. With the people of Europe, even where the subjects of legislation have been comparatively open to discussion, the two terms, innovation and danger, seem almost synonymous; and one class of men are always ready to resist a change without examination, merely because it is a change. The most serious inconveniences would undoubtedly result from a continual volatility in political measures. But there is no danger against which the universal character of man provides so completely; for there are no prejudices so strong as those which support the established order of things.

We have thus, as it were, made the tour of a human being, [illegible] origin, [illegible] finite [illegible] by which [illegible] to discover [illegible] are aware, [illegible] great degree, [illegible] are connected [illegible] that very often the [illegible] or more of the [illegible] parate. Some [illegible] result from thus [illegible] our thoughts to the [illegible] foreseeing, as it were, our [illegible] ist. In referring our [illegible] arbitrary as it may seem to be, [illegible] much they may be influenced [illegible] tion, sensibility, and mental [illegible] successively of all their accessaries; [illegible] over to an impartial examination; [illegible] the test of this analysis, we will be [illegible] truth; if they are found to have their [illegible] dice, we will at least be delivered from [illegible]

little more at- Preservers,
ving Life.

ANALYSIS OF THE FOREGOING TREATISE.

Prejudice is an opinion formed before reason has discussed the soundness and propriety of it, page 139

Man, in the first stages of his life, necessarily resigns himself to prejudice, 140

He cannot at once emancipate himself from its influence, and substitute reason in its stead, 140

When doubt is entertained on the subjects of our belief, we subject them to a careful investigation, which leads to conviction and certainty, 140

Even to the end of life, men of the most philosophical minds have occasion to resist and guard against a great number of prejudices, 140

Relation and difference between prejudice and presumption, 140

Prejudice has its origin in the dispositions of our mind, presumption in the circumstances of any subject submitted to our judgment, 140

We transform into prejudice the presumptions which have been communicated to us by others, 140

The following division includes the chief sources of prejudice, namely, memory, imagination, sensibility, and mental indolence, 141

I. *Prejudices of Memory.*

The veneration we pay to the remembrances of our childhood, 141

We delight to recal that period when our pleasures and our hopes were so lively and fascinating, 141

The love which people bear towards their kings would be almost inexplicable, if the king was not, in their associations, the representative of the times that are past, 142

The respect for ancient families, ancient governments, and ancient laws, has its origin in the same feeling, 142

The slow and difficult conversion of those, in any religion, who have been long distinguished by incredulity or a worldly life, 142

This conversion, when it does take place, is always in favour of that theological system which we were taught to believe and reverence in early life, 142

When we become the victims of doubt, we regret the faith we abandon as we regret the days of our youth, 142

The remembrances of youth give duration and stability to social institutions, 142

But these remembrances have a contrary effect, if the established order of things is new, and if we can recollect an order which it has superseded, 143

The illusions of memory cause that unsettled and precarious state of affairs which follow political or religious revolutions, 143

II. *Prejudices of Imagination.*

Constant effort of the imagination to substitute whatever is wonderful in place of what is real, 143

The wonderful, presented to us in works of poetry and romance, as a play of the imagination, pleases us in proportion as it deceives us, 143

There is a universal tendency in the human race to believe popular traditions and superstitions, 143

The wonderful is not unknown in real life, as, for example, the interest so invariably taken in unfortunate kings, 144

Of all human events, war is most nearly allied to this feeling, 144

The marvellous in religious belief; mystery is a great source of the marvellous, 144

The protestant churches by degrees renounced that examination of their faith by which they were at first distinguished, 144

History of heresies; the most difficult of their opinions is always preferred, 144

The love of the marvellous affects every kind of testimony, 145

We may suspect the truth of opinions that partake of the wonderful, though we can place the utmost confidence in the persons who entertain them, as they may involuntarily be the victims of prejudice, 145

III. *Prejudices of Sensibility.*

The absence of emotions, 145

False opinions have not always their origin in our faculties, but our faculties transform them into prejudices, 145

Analysis of mournful emotions; we easily imbibe a prejudice in favour of what excites our pity, 145

Analysis of pleasurable emotions; prejudice in favour of what excites them, 145

Inquiry into the sentiments of love and hatred, 146

We extend sympathy and antipathy from persons to things, 146

This sympathy or internal moral sense ought always to be influenced and regulated by the suggestions of reason, since the one rectifies and confirms the other, 146

Truth being one and the same under all circumstances, the moral sense and enlightened reason ought always to agree and be reciprocal, 146

Sympathy, applied to persons, is the most amiable of our prejudices, 146

Antipathy is the most odious, though it has often been re-

Prejudices.

presented as a virtuous sentiment, 146

Antipathy is an artifice which kings and chiefs make use of to excite their followers or subjects against their neighbours or rivals, 147

The sentiments natural to man could never have given it origin, 147

IV. *Prejudices of Mental Indolence and Inactivity.*

The activity of the mind decays, and the most part of men regard mental application, and the jarring and opposition of different opinions, as a fatigue, and avoid it, 147

The less we have submitted our prejudices to examination, the more we fear to do so, 147

In a mind which has lost the habit of reflecting, doubt conducts directly to incredulity; whilst by an active mind, it forms the basis of investigation, and excites to it, 147

Men resist with obstinacy the first symptoms of suspicion and of doubt, 148

The less they have investigated the nature and merit of their public institutions, the more prepared are they to defend them with obstinacy, 148

This obstinacy is increased by personal and national pride, 148

The unshaken stability of the oppressive governments of the east, takes its rise in this mental indolence, 148

This same prejudice gives permanency to the works and enactments of legislators, though their tendency be ever so despotical and injurious, 148

Nations, where civilization is making no progress, deteriorate, from the indolence and inactivity of the human mind, 148

There is a prejudice against innovations among all people, 149

The classification of prejudices, which has been established in this treatise, may be of use in our inquiry after truth, and in avoiding error, 149

Preposition ‖ Prescot.

PREPOSITION. See GRAMMAR, Vol. X. Chap. VIII. p. 439—442.

PRESBURG, or POSING, a town of Hungary, and the capital of the kingdom, is agreeably situated on an eminence, on the north side of the Danube, and commanding a view of the extensive plains through which that river flows. The town is ill built; the streets are steep and narrow, and the houses rather mean. The suburbs are much handsomer, and display some modern improvements. The town contains two squares, ornamented with statues. The principal churches are old gothic edifices, built in 1090. Among the other public buildings, are the residence of the palatine of the country, the town-house, the barracks, the corn-market, the public granaries, the palace of Bathiany, the cupola of the church of St. Elizabeth, a college with a gymnasium and church, besides seven convents, a Protestant school, a Lutheran church, and two hospitals. The Danube, which is about 125 fathoms wide, is crossed by a flying bridge. The Chateau of Lanschitz, in the neighbourhood of Presburg, and the chateau of Esterhazy, are well worthy of being visited. The principal promenades are the one on the island at the flying bridge, that at the mills, the one before the great Café, and that opposite the palace of Bathiany, besides the gardens of Counts Erdoedy and Groschalkowitzi. The principal manufactures are those of woollen, silk, oil, tobacco, and snuff. Population about 30,000. East Long. 17° 10′ 45″, North Lat. 48° 8′ 28″.

PRESBYTERY. See SCOTLAND.

PRESCOT, a market town of England, in Lancashire. It is situated on an eminence on the great road from London to Liverpool and consists principally of three paved streets, surrounded by numerous collieries, some of which are beneath the town. The church, which is large and spacious, has a steeple 156 feet high. There are also here a meeting-house for dissenters, a free school, and several alms houses.

Prescot has long been known for its manufacture of watch-tools and of watch-movements, of pinion-wire, and files. Coarse earthen ware, cotton goods, and sailcloths, are also made here. For a brief account of the plate-glass works at Ravenhead, see ENGLAND, Vol. IX. p. 10. Population of the township in 1821, 4468. West Long. 2° 48′, North Lat. 53° 26′. See Dr. Aikin's *Description of the Country thirty or forty miles round Manchester,* 1795; and the *Beauties of England and Wales,* vol. ix. p. 226.

PRESERVERS, LIFE, is a name which has been given to various mechanical contrivances, for saving the lives of individuals, either in cases of shipwreck, drowning, or exposure to fire.

Under the article BOAT *Life,* in Vol. III. p. 619, we have already given a full account of the life boats of Lukin, Wilson, Greathead, and Bremner, and of other inventions for preserving lives in cases of shipwreck, &c.

Captain Manby's apparatus.

Different contrivances have, since that time, been proposed for giving assistance in case of shipwreck; but the most important of them is that of Captain Manby, which he has explained at length in his *Essay on the Preservation of Shipwrecked Persons,* Lond. 1812. This plan consists in affixing a rope to a shot, and firing it from a light piece of ordnance over a vessel in distress, and near enough the shore. A communication with the shore being thus established, a boat can be hauled to the relief of the crew.

This ingenious contrivance was in many cases eminently successful in saving the crew of different ships; and Captain Manby was honoured with a parliamentary reward for his apparatus, having previously received the gold medal of the Society of arts in 1808. The following results of some of Captain Manby's experiments, will show the effects which are produced by the apparatus.

5¼ Inch Brass Mortar.
Angle of elevation 17°.
Weight of mortar and bed, 3 cwt.

Ounces of Powder used.	Yards of Inch and Half Rope.	Yards of Deep Sea Line.
4	134	148
6	159	182
8	184	215
10	207	249
12	235	290
14	250	310

With a short eight inch mortar, the weight of which, and its bed, was 7 cwt. the elevation being unknown, 32 ounces of powder projected in one experiment 439 yards of deep sea line, and in another 479 yards; while in a third experiment it projected 3367 yards of 2¼ inch patent Sunderland rope, which had strength enough to haul the largest boat from a beach.

Mr. Murray's apparatus.

As there is necessarily considerable practical difficulty in managing Captain Manby's apparatus, both from the snapping of the rope and the difficulty of adjusting the charge and elevation to the distance of the ship, it occurred to Mr. John Murray, lecturer on chemistry, that a musket and a musket bullet might be substituted in place of the mortar and ball of Captain Manby's apparatus. He proposes to affix a line of whip-cord to arrows of ash, hickory, and sometimes iron, loosely filling the calibre of the musket, and to fire off these arrows with a charge of gunpowder less than the usual quantity. The arrows are three or four inches longer than the barrel of the musket, and are shod with iron at the point, having an eye through which the line is thrown. The lower end enters a socket, which must be in complete contact with the wadding of the piece. The average distance to which an arrow and a logline were projected, was about 230 feet, though in one case, an iron rod was carried 333 feet; but in this case the line was favourably placed. Mr. Murray considered that whip-cord was strong enough to carry a log-line, and a log-line strong enough to carry a rope on board.

Mr. Murray has proposed the same method for projecting the arrow over lofty buildings on fire, and thus to carry a line attached to a lengthened rope-ladder, which could be drawn over the roof to the other side, and thus instantaneously establish free egress for the unfortunate inmates. The ends of the rope-ladder should be fastened into the pavement by means of iron staples.

An apparatus for saving lives in cases of shipwreck by Mr. H. Trengrouse, is described in the 38th volume of the *Transactions of the Society of Arts*, p. 161—165. The projecting force which he used in the apparatus is a rocket; and it was found that a rocket of 8 oz. with a mackerel line attached to its stick, ranged to the distance of 180 yards, and that a pound rocket, in similar circumstances, ranged 212 yards. The rocket is placed in a copper instrument, at the end of a musket, charged with a small quantity of powder, without wadding; for the purpose merely of directing and igniting the rocket. The rocket, when lighted by the powder, burns a few seconds before it acquires sufficient momentum to quit its situation; during which time the combustible would be ejected into the barrel of the gun, if it were not prevented by a loosely suspended valve, which opens to permit the passage of the charge, but immediately closes, and prevents the barrel from being choked by the retrograde discharge from the rocket.

In the year 1822, Captain Dansey of the Royal Artillery communicated to the Society of Arts the description of a kite and apparatus for obtaining a communication with vessels stranded on a lee shore, or otherwise, where badness of weather renders the application of the ordinary means impracticable. A sail of light canvass, or holland, being cut to the size, and adapted for the application of the principles of the flying kite, is launched over the vessel, or other point to windward, of the space over which a communication is required, and as soon as it appears to be a sufficient distance, a simple mechanical apparatus is used to destroy its poise, and cause it to fall immediately, but remaining still attached by the line, and moored by a small anchor with which it is furnished. The results of the experiments made by Captain Dansey with a kite of 60 feet of surface, has been in a strong breeze the extension of a line of sixty pounds weight, 350 yards long, and $1\frac{3}{4}$ inch in circumference. In another experiment, he extended a line of 37 pounds weight, 1100 yards long, and $\frac{5}{8}$ths of an inch in circumference. In using this apparatus, little more attention or skill is said to be necessary than in flying an ordinary kite.

Preservers, Life.

A minute description of this ingenious apparatus, accompanied with drawings, will be found in the *Transactions of the Society of Arts*, vol. xli. p. 182.

Among the inventions for preserving lives at sea, we may enumerate:

Enumeration of other life preservers.

1. The safety buoy and life-boat of Mr. Boyce, consisting of hollow canvass cylinders, painted and varnished, and connected with each other. See *Transactions of the Society of Arts*, vol. xxxii. p. 177. 1814.

2. The contrivance of Mr. G. Bray, was, in 1818, of a boat filled with air-boxes, placed under the seats and along the sides. *Id.* vol. xxxv. p. 172.

3. Mr Thomas Cook's life-buoy, for preserving the life of a person who falls overboard in the night. *Id.* vol. xxxvi. p. 121.

Method of saving persons that have sunk in the ice of lakes.

Among the machines for saving persons in the act of drowning, we may mention a very ingenious one which has been used for some time at Duddingstone Loch, near Edinburgh, under the sanction of the Skating Club. As this loch is much resorted to when frozen over, for the purpose of skating, several persons have been drowned from the ice giving way in particular places. In order to give assistance to persons who have sunk in the ice, a rope is placed so as to surround the whole lake. This rope is at the command of any spectator, at any part of the circuit of the lake, and when any person needs assistance, another at the margin of the lake has only to take hold of the rope, and drag it towards him. The rope must necessarily pass over the spot where the person in danger has sunk; so that, by taking hold of it he may be dragged on the ice, or be enabled to reascend.

Fire escapes.

Under our article Fire Escapes, Vol. IX. p. 352, we have given an account of various inventions for this purpose. To the machines there described may be added, Mr. Braby's fire-escape, described in the *Transactions of the Society of Arts* for 1816, vol. xxxix. p. 227. It consists of a car made to slide on a strip of plank, fixed to a pole, and directed by a rope.

PRESS, is the name given to a machine for compressing any substance or substances, and retaining it under that compression as long as it may be required.

Various presses, used for general purposes in the arts, have been described under different articles in this work.

A *Simple Lever Press* is represented in Bramah's *Bank Note Press*, described under that article, Vol. IV. p. 403, and represented in Plate LXXVI. In this press, the force of the hand applied at the extremity F, of the lever FD, Fig. 1, produces a power at F, where the type on the left hand of E is impressed upon the bank-note above it.

The *Common Lever Press* is shown in Fig. 4, Plate LII. where the two plates CC, BB are pressed together by means of the screw D and the cast-iron wheel E, to which a lever may also be applied. Another drawing of the same press is shown in the *Coining Press*, Plate CCI. Fig. 8.

The *Hydrostatic Press* of Bramah has been amply described under the articles Bandana, Crane, Calender, and Hydrodynamics. References to other machines described in this work, and acting by compression, will be found under Mechanics, Vol. XIII. p. 619.

PRESSES, Printing. See Printing Presses.

PRESSES for copperplate printing. See Printing Press.

PRESTER-JOHN, or Jean, is the name given to the emperor of the Abyssinians. The word *Jean* signifies *priest* in the Abyssinian language; and the princes of the country having been priests, the appellation Prester-John was naturally applied to them by foreigners; the name being entirely unknown in that country.

PRESTON, a large and thriving borough and market town of England, in the county palatine of Lancaster. The town is situated on an eminence rising from the north bank of the river Ribble, across which a new bridge was erected in 1781. The streets are broad and regular, and the houses handsome and recently built. The parish church is a large building, and the parish has three chapels of ease, Broughton, St. Laurence, and the New Chapel. The town-hall is a very large and handsome building, containing a picture of George II. The assembly rooms, which were built at the sole expence of the Earl of Derby, are elegant and commodious. The new prison, or penitentiary-house, near the entrance of the town from Chorley by Walton Bridge, is constructed on the plan of Mr. Howard, and has for its object solitary confinement and reformation only. The charities consist of two schools, one for twenty-five boys, and the other for twenty-five girls. Cotton goods, and other manufactured articles, are made here in great quantities, and are exported by means of the river Ribble, which is navigable to the town for vessels of considerable burden, and for barges and boats ten miles higher. Preston likewise carries on some foreign and coasting trade. The government is vested in the mayor, two bailiffs, recorder, aldermen, common council men, and a town clerk. The town returns two members to parliament, who are chosen by about 600 electors. Near the town there are many fine walks, but the favourite one is that of Haynum, from which Prince Charles is said to have viewed the town and the country below it in 1745 with extraordinary emotions.

According to the census of 1821, the population of the borough of Preston is,

Houses,	4014
Families,	4989
Do. employed in trade,	4629
Males,	11,856
Females,	12,719
Total population,	24,575

See *the Beauties of England and Wales*, vol. ix. p. 106; and Dr. Aikin's *Description of the Country thirty or forty miles round Manchester.*

PRETTIGAU, is the name of one of the divisions of the Grisons in Switzerland. It comprehends the districts of Kloster, Castels, and Schiers. It forms a valley eight leagues in length, and four in breadth. It is well peopled, and is supposed to have been the territory of the Rucantii. The land is fertile, particularly in pasturage. The baths of Gavey, which were formerly celebrated, are in the district of Schiers.

PRICE, Dr. Richard, a celebrated author, was born at Ty-yn-ton, in Glamorganshire, on the 22d February 1723. Having received the rudiments of his education at Neath, he was placed in 1735 under the care of the Rev. Samuel Jones; and, with the view of being educated to the clerical profession, he went in 1739 to the academy of the Rev. Vavasor Griffith of Talgarth. After the death of his father and mother in 1739 and 1740, he was sent to London, to his uncle, the Rev. Samuel Price, and was entered a student in the academy, of which Mr. Eames was the head tutor. After studying mathematics and ethics, &c. at the academy for four years, he became domestic chaplain to Mr. Streatfield of Stoke-Newington. In 1757, he married, and in 1758 he became pastor of the congregation of Newington Green. In the same year he published his first work, entitled, *A Review of the Principal Questions and Difficulties in Morals*, which added greatly to his reputation, and which went through several editions. The fundamental principle maintained in this work, is that it is the understanding, and not the moral sense which determines concerning actions.

In 1763, Mr. Price was chosen afternoon preacher to the congregation in Poor Jewry Street. In 1769, he gave to the Royal Society a demonstration of a rule in the doctrine of chances, and, on the 5th December 1765, he was admitted a fellow of that learned body. In 1767, he published four dissertations, on Providence, Prayer, &c. In 1769, he communicated to the Royal Society, "Observations on the Expectations of Lives, the Increase of Mankind," &c. which was afterwards reprinted with corrections and additions in his work on Reversionary Payments, &c. which appeared in 1771. This valuable work went through several editions. The important topics of public credit, and the national debt, which were discussed in that work, were treated of at greater length in an "Appeal to the public on the subject of the national debt," which appeared in 1778.

During the American war, Dr. Price entered into the political controversies of that period, and published several pamphlets on the nature and value of civil liberty, which are now forgotten. The next work which he composed, was "A Free Discussion of the Doctrines of Materialism and Philosophical Necessity," in a correspondence between Dr. Price and Dr. Priestley.

When Lord Shelburne was prime minister, he was assisted by Dr. Price in drawing up a scheme for paying off the national debt, but a change of ministry frustrated this scheme, and induced Dr. Price to communicate it to the public, in a treatise, entitled, "The state of the Public Debts and Finances, at signing the preliminary articles of peace in January 1783; with a plan for raising money by Public Loans, and for redeeming the Public Debts." At a subsequent period, Mr. Pitt is said to have received from Dr. Price three separate plans of a sinking fund, one of which formed the foundation of the system now in operation.

In 1784 Dr. Price published "Observations on the Importance of the American Revolution, and the means of making it useful to the World;" and in 1786 he published a volume of sermons, partly on practical, and partly on doctrinal subjects. When a new academical institution was established by the dissenters in 1786, at Hackney, Dr. Price was appointed tutor in the higher branches of the mathematics; but he soon after resigned that situation in favour of his nephew, the Rev. George Cadogan Morgan, author of Lectures on Electricity, and of a paper, in the *Philosophical Transactions* for 1785, on the light of bodies in a state of combustion.

In a sermon "On the love of our country," preached on the 4th Nov. 1789, before the society for commemorating the Revolution of 1688, Dr. Price adverted with triumph to the revolution which had then begun in France. These observations exposed him to the severe invectives of Burke, in his *Reflections on the Revolution in France*.

Dr. Price had lost his wife in 1786; and in Feb. 1791, he had been seized with a fever, from which he was just recovering, when he was attacked with a painful disorder, which had threatened him for several years. Of this attack he died, on the 19th March, 1791, in the 68th year of his age.

Besides the articles which we have mentioned, Dr. Price communicated to the *Phil. Trans.* for 1770, a paper *On the Effects of the Aberration of Light on the time of a Transit of Venus.* In the same work for 1774. he printed a letter on the *Insalubrity of Marshy Situations;* and in the volume for 1775, he published his *Observations on the Difference between the Duration of Human Life in Towns and in Country Parishes and Villages.* His *Short and Easy Theorems on Annuities* were printed in the *Transactions* for 1776.

Few individuals have enjoyed greater celebrity than Dr. Price, both for talents and personal character. His nature was strongly marked with humility and unaffected modesty. The philanthropy which distinguishes his writings was exhibited in a practical form, by the devotion of a fifth part of his annual income to charitable purposes.

PRIESTLEY, Joseph, a celebrated English philosopher and divine, was born at Field-head, about six miles from Leeds, on the 24th March, 1773. His father, Jonas Priestley, was a woollen manufacturer, and a dissenter of the Calvinistic persuasion. An aunt, Mrs. Keighly, by whom Joseph was early adopted, gave him a good education at several schools in the neighbourhood; and being intended for a dissenting clergyman, he was sent, in 1752, to the academy at Daventry, then kept by Dr. Ashworth, the successor of Dr. Doddridge. After spending three years at this institution, where he had imbibed the doctrines of Hartley, and the principles of Arianism, he settled as a minister at Needham Market, in Suffolk, in an obscure dissenting meeting-house, where his income never exceeded L.30 per annum. After a residence of three years in that situation, he undertook the charge of a congregation at Nantwich, in Cheshire, where he superintended also a school, teaching in public and in private about twelve hours every day. In 1761 he published an English Grammar, which was his first work; and, in the same year, he was called by the trustees of the academy at Warrington to the situation of tutor in the languages. In this situation he continued for six years, engaged in the occupation of teaching, and in various literary and scientific pursuits. His *History of Electricity,* which he published in 1767, in one volume 4to. and which he dedicated to the Earl of Morton, the president of the Royal Society, first brought him into notice as an experimental philosopher. This work passed through several editions, and was translated into several foreign languages. While he was engaged in this work, he received the degree of LL. D. from the university of Edinburgh; and on the 12th June, 1766, he was elected a member of the Royal Society of London.

During his residence at Warrington, Dr. Priestley married the daughter of Mr. Isaac Wilkinson, an ironmaster in Wales, by whom he had a family. Thus comfortably settled, though with the small income of L.100 per annum, and L.15 for each boarder, Dr. Priestley devoted himself to the labours of literature; but a difference having arisen between Dr. Taylor and the trustees of the academy, in which the other teachers were necessarily involved, Dr. Priestley was induced to accept an invitation to Mill-hill chapel, Leeds, where he went in 1767. In this new situation, the accidental proximity of a brewery directed Dr. Priestley's attention, in 1768, to the subject of pneumatic chemistry, which he afterwards prosecuted with such distinguished success. He invented the apparatus still used by chemists in this branch of their science.

In 1772, he published a pamphlet on the method of impregnating water with fixed air, and on the preparation and medicinal uses of artificial mineral waters. In the same year, he read to the Royal Society his *Observations on different kinds of air,* for which he obtained the Copley medal, "the palm and laurel of the Royal Society," as Sir John Pringle denominated it in presenting it to Dr. Priestley.

The success of his *History of Electricity,* induced our author to conceive the extensive design of printing a similar historical account of the other sciences. He accordingly published in 1772, in one volume 4to. when he was in Leeds, his *History and Present State of Discoveries relating to Vision, Light, and Colours,* a work which, though both instructive and amusing, contains but a very superficial history of optical discovery, and is obviously written by one whose acquaintance with that science was very limited and imperfect. The sale of this book did not answer the expectations of its author, and indeed does not seem to have defrayed its expences.

In the year 1773, the Earl of Shelburne, afterwards Marquis of Lansdowne, was induced, by a recommendation from Dr. Price, to engage Dr. Priestley as a librarian and literary companion, with a salary of L.250 a year and a house. He accordingly took up his residence at Colne, near his Lordship's seat in Wiltshire, and during seven years he continued in that situation, attending Lord Shelburne during his residence in London. In 1774, he accompanied his Lordship abroad, and travelled with him through Holland, France, and part of Germany.

While he was living with Lord Shelburne, he brought out the first three volumes of his *Experiments on Air,* and he collected the materials for a fourth volume, which was published after his removal to Birmingham.

The pursuits of experimental chemistry did not prevent our author from directing his attention to his favourite subject of metaphysics. In 1775, he published his *Examination of the Doctrine of Common Sense, as held by Drs. Reid, Beattie, and Oswald;* a book which he assures us was written in a fortnight. Having become a convert to materialism, he published, in 1777, his *Disquisitions on Matter and Spirit,* in which that system is openly supported. This work was followed by *A defence of Unitarianism, or the simple Humanity of Christ, and of the Doctrine of Necessity;* and it has been thought probable, that the odium which these works entailed upon the author, was the ground of a coolness on the part of Lord Shelburne, which led to the dissolution of their connexion. Dr. Priestley retained an annuity of L.150 for life; and it has been said that when the bond was burnt during the riots at Birmingham, his Lordship transmitted to him another. The cause of his separation from Lord Shelburne is not known. One of his biographers, however, states that Lord Shelburne declined receiving any

Priestley, Dr.

visits from Dr. Priestley; and Dr. Priestley assures us, that he never in any way aided his patron in his political views.

The diminution of income which attended this event, was made up by very considerable presents from Mrs. Rainer; and by means of a subscription, he had an annuity of some considerable amount secured to him.

Having removed to Birmingham in 1780, he was soon after unanimously appointed to the principal dissenting congregation in that town. Here he published the last three volumes of his *Experiments on Air*, and a variety of papers on the same subject in the *Philosophical Transactions*. These peaceful pursuits, however, were disturbed by his passion for theological and political controversy. His *History of the Corruptions of Christianity*, and his *History of Early Opinions concerning Jesus Christ*, together with his exertions respecting the repeal of the corporation and test acts, involved him in controversies which, if they did not disturb the tranquillity of his mind, must at least have interrupted his philosophical pursuits.

His *Familiar Letters to the Inhabitants of Birmingham* had excited considerable irritation from the ironical style in which they were written; and his answer to Mr. Burke's work on the French revolution brought down upon him in the House of Commons the thunders of this great man's eloquence. The press teemed with attacks upon him; and in this state of excitement the anniversary of the capture of the Bastile was celebrated at Birmingham on the 14th July, 1791. Although Dr. Priestley declined joining the party, yet the tide of popular feeling set strongly against him, and during the disgraceful riots which ensued, his church and house were burned, his library, apparatus, and manuscripts destroyed, and he himself was forced to seek for safety in flight. The houses of several of his friends were also burned down, and his son escaped from death only through the care of a friend who kept him in concealment for several days.

After the storm which thus threatened him had blown over, he took up his residence at Hackney, and in a short time he succeeded his deceased friend Dr. Price, in the meeting-house at that place. The resources of his mind, and the active pursuits of science, restored to him for a while that tranquillity which had been so unexpectedly disturbed; but his opinions had excited against him such a crowd of enemies, that he saw no hope of enjoying permanent comfort by continuing in this country. The Royal Society declined admitting him to their meetings, and he was obliged to withdraw his name from its list of members. His sons had renounced their native country and emigrated to France, and their father, finding himself thus deserted, even by his own family, resolved upon leaving England. He accordingly embarked for America, in April, 1795, and went to reside in the town of Northumberland in Pennsylvania. He was offered the professorship of chemistry in Philadelphia, soon after his arrival; but he declined engaging in any public employment.

Even in America Dr. Priestley was viewed with a sort of suspicion and distrust which it is not easy to explain; and it was not till the administration of Jefferson, who treated him with kindness, that all disquietude on that head was removed. The death of his youngest son, and of his wife, and other domestic calamities, embittered the rest of his life, and a complaint in his digestive organs began gradually to undermine his constitution. In January, 1804, the disease had got beyond the reach of medical skill, and on the 6th of February, 1804, he expired, in the 71st year of his age.

An account of Dr. Priestley's chemical discoveries will be found in our article CHEMISTRY, vol. V. and under ATMOSPHERE, vol. III. p. 50, &c.

The following is a list of his papers in the *Philosophical Transactions:*

1. Account of rings, with all the prismatic colours made by electrical explosions on the surfaces of pieces of metal. *Phil. Trans.* 1768, p. 68.
2. Experiments on the lateral force of electrical explosions. *Id.* 1769, p. 57.
3. Various experiments on the force of electrical explosions. *Id.* 1769, p. 63.
4. An investigation of the lateral explosions, and of the electricity communicated to the electric circuit, in a discharge. *Id.* 1770, p. 192.
5. Experiments and observations on charcoal. *Id.* 1770, p. 211.
6. Observations on different kinds of air. *Id.* 1772, p. 147.
7. An account of farther discoveries on air. *Id.* 1775, p. 384.
8. An account of Henley's electrometer. *Id.* 1772, p. 359.
9. On the noxious quality of the effluvia of putrid marshes. *Id.* 1774, p. 90.
10. On respiration and the use of blood. *Id.* 1776, p. 226.
11. Experiments relating to phlogiston, and the seeming conversion of water into air. *Id.* 1783, p. 390.
12. Experiments and observations relating to air and water. *Id.* 1785, p. 279.
13. Experiments and observations on the principle of acidity, the composition and decomposition of water, and phlogiston. *Id.* 1778, p. 147, 313; 1789, p. 7.
14. Experiments on the phlogistication of spirit of nitre. *Id.* 1789, p. 139.
15. Experiments on the transmission of the vapour of acids through a hot earthen tube, and farther observations relating to phlogiston. *Id.* 1789, p. 289.
16. Observations on respiration. *Id.* 1770, p. 106.
17. Farther experiments relative to the decomposition of dephlogisticated and inflammable air. *Id.* 1791, p. 213.

For farther information respecting the life and writings of Dr. Priestley, see *Memoirs of Dr. Joseph Priestley*, in 2 vol. 8vo.; and Dr. Thomson's *Biographical Account of Dr. Priestley*, in the *Annals of Philosophy*, vol. i. p. 81.

PRIME NUMBERS. See NUMBERS, Vol. XV. p. 412.

PRINCE OF WALES'S ISLAND, or PULO PENANG, is an island separated from the west coast of the Malay peninsula by a strait about two miles in breadth. The island, which is of an irregular quadrangular shape, is about five leagues long and seven or eight broad, and contains about 160 square miles. An elevated range of hills passes through the heart of the island, diminishing in size as they go southward, and sending out numerous streams, which water the island. The Flagstaff-hill is estimated to be 2500 feet above the sea. Upon it the thermometer seldom rises above 74°, and never above 78°, and falls to 66°, while, in the plains, it ranges between 76° and 90°.

The soil is commonly a light black mould, mixed with gravel, clay, and sometimes sand. The forests which cover the island yield excellent timber, and the lower masts of a seventy-four have been got of one piece. A great part of the north, and much of the south and east sides of the island, are in a state of cultivation.

"The principal productions," says Mr. Hamilton, "are pepper, betel nut, betel leaf, cocoa nuts, coffee, sugar, paddy, ginger, yams, sweet potatoes, and a great variety of vegetables. The fruits are, the mangosteen, ramboosteen, pine apples, guavas, oranges, citrons, pomegranates, &c. &c. The exotics raised here are, cloves, nutmegs, cinnamon, pimento, kyapootee, colalava, and a number of other plants from the Moluccas and eastern isles. Pepper is the chief article of cultivation. The quantity raised in 1804 was calculated at two millions of pounds.

"The elastic gum vine, (*Urceola elastica,*) or American caoutchouc, is found in great plenty on Prince of Wales's Island. It is about the thickness of the arm, almost round, with a strong ash-coloured bark, much cracked, and divided longitudinally, with points at small distances, that send out roots, but seldom branches. It creeps along the ground to the distance of more than 200 paces, then ascends among the branches of high trees. The milky juice of the vine is drawn off by wounding the bark, or by cutting the vine in pieces. The best is procured from the oldest vines, which will yield two-thirds of their weight of gum. The chemical properties of this vegetable milk surprisingly resemble those of animal milk."

George Town, the principal place in the island, has spacious and airy streets, crossing at right angles. The chief buildings are, the government house, a church, a jail, and several good bridges. The fortifications have been recently strengthened and improved, and the public roads repaired. Fort Cornwallis, containing barracks, the arsenal, magazine, and military storehouses, are built on the north-east point of the island. The pier, for landing and shipping goods, is large, and is supplied with fresh water in pipes. Ship-building has been carried on here to a considerable extent: a frigate, a ship of 800 tons, and various others of inferior size, having been built.

The country ships bound eastwards, generally touch here to refresh and trade. The East India Company's ships for China likewise touch here, and load great quantities of tin, canes, rattans, sago, pepper, betel nut, biche de mar, birds' nests, &c. for the China market. The whole trade, indeed, of the straits of Malacca and the adjacent islands now centres in this small island.

The goods imported from Europe are, anchors, cutlery, fire-arms, nails, tin ware, patent shot, sheet-lead, sheet-copper, iron, cables, canvass, cloth, glass ware, hosiery, musical instruments, watches, malt liquors, wines, &c. In 1807-1808, the value of the imports from England was £76,000, and in 1809-1810, £38,253. The imports from Bengal are opium, grain, and piece goods; from the coast of Coromandel, salt, tobacco, punjam cloths, coir rope, and yarn; from Bombay and the Malabar coast, cotton, salt, red wood, sandal wood, Surat piece goods; from Borneo, gold dust, sago, and black wood; from China, tea, sugar, lustrings, china ware, and all articles required by the Chinese settlers. A great proportion of the exports from this island consists of articles imported. In 1807-1808, the woollens imported into this island amounted to £46,783.

This island was granted, in 1785, to Captain Light, of a country ship, by the King of Queda, as a marriage portion with his daughter. Captain Light transferred it to the East India Company, and was appointed its first governor, in 1786.

From the number of tombs discovered on the island it would appear to have been formerly inhabited, though there were only a few wretched fishermen on the coast when it was taken possession of.

The population in 1797 was 6937, in 1801 it was 10,310, of whom 1222 were slaves, and in 1810 it was 14,000. The population consists of English, Dutch, Portuguese, Americans, Arabs, Parsees, Chinese, Chulias, Malays, Buggesses, Burmans, Siamese, and Javanese. The north-east point is situated in East Long. 100° 19′, and North Lat. 5° 25′. For more minute information respecting this island, see Sir George Leith's *Account of Prince of Wales's Island*, in the Asiatic Annual Register; Elmore's *Navigation of the Indian and Chinese Seas*; Hamilton's *East India Gazetteer*; and Milburn's *Oriental Commerce*, vol. ii. p. 297—304.

PRINGLE, Sir John, an eminent Scottish physician, and president of the Royal Society of London, was born at Stitchel-house, in Roxburghshire, on the 10th of April, 1707. He was the youngest son of Sir John Pringle, Bart. of Stitchel, and of Magdalen Elliot, sister of Sir Gilbert Elliot. After receiving, under a private tutor, the elements of a classical education, he went to the College of St. Andrews, where Mr. Francis Pringle, a relation of his own, held the Greek professorship. Having resolved to follow the medical profession, he spent the session of 1727 and 1728 in Edinburgh; but he repaired at the end of the year to Leyden to study under the celebrated Boerhaave, who was then considerably advanced in life. At his graduation in that university, in July 1730, he wrote an inaugural dissertation, *De Marcore Senili*; and he soon afterwards established himself as a physician in Edinburgh. Having had occasion to devote his attention to ethics, he was made joint professor of moral philosophy with Mr. Scott, in March 1734; and, after the death of his colleague, he discharged the duties of that office, along with those of the medical profession, till 1742, when on the recommendation of Dr. Stevenson, he was nominated physician to the Earl of Stair, who was then at the head of the British army. In the autumn of the same year he was chosen physician to the military hospital in Flanders; but he still retained his professorship, the duties of which were discharged by a substitute.

Having accompanied our army to Flanders, during the campaign of 1744, his diligence and talents were so conspicuous, that the Duke of Cumberland appointed him physician-general to his Majesty's forces in the Low Countries, and also physician to the royal hospitals. On the 31st October, 1745, he was elected a fellow of the Royal Society; and in the same year he was recalled from Flanders to attend the army sent to Scotland. He accordingly accompanied the Duke of Cumberland in 1746, and continued with the army in Scotland till the dispersion of the Highlanders at Culloden permitted their return to England. His services were again required abroad, and in 1747 and 1748 he attended the British army; but after the peace of Aix-la-Chapelle, he returned to England in 1748.

Being again settled in London as a medical practitioner, Dr. Pringle devoted himself to the studies of his profession. In the year 1747, the Duke of Cumberland appointed him his physician in ordinary; and in 1750 he published his *Observations on the Gaol or Hospital Fever*.

The first paper which Dr. Pringle communicated to the Royal Society, was his *Experiments on Substances resisting Putrefaction*, which appeared in the *Transactions* for 1750,[*] and which were reprinted in his *Observations on the Diseases of the Army*, which appeared in 1752, and were translated into several languages. These experiments were considered of sufficient importance to entitle their author to Sir Godfrey Copley's gold medal. In the *Phil. Trans.* for 1753, he published his *Account of several persons seized with the Gaol Fever by working in Newgate*;[†] and in the same year he communicated *A remarkable case of Fragility, Flexibility, and Dissolution of the Bones*.[‡] The next paper of any importance which our author published, was a collection of *Several Accounts of the Fiery Meteor, which appeared on the 26th Nov.* 1758,[||] which was followed by *Remarks on the several Accounts of the Fiery Meteor, and other such Bodies*.[§]

In the year 1752, Dr. Pringle married the second daughter of Dr. Oliver of Bath; but he had the misfortune of being a widower in three years. After the war which commenced in 1755, Dr. Pringle attended the camps in England for three years; but in 1758, he quitted the service entirely, and was in the same year admitted a licentiate of the College of Physicians.

On the accession of George III. Dr. Pringle was nominated physician to the queen's household in 1761; and in 1763, physician extraordinary to the queen. In the same year he was elected a fellow of the Royal College of Physicians; and he succeeded Dr. Wollaston in 1764, as physician in ordinary to the queen. In 1766, the dignity of a baronet of Great Britain was conferred upon him.

The honours which were thus crowding upon him from every quarter, were completed by his election to the presidency of the Royal Society, on the death of James West, Esq. The satisfaction which he gave in this dignified capacity, has been so much spoken of, and excited so much interest, that we shall lay before our readers the account of his presidency, which has been drawn up by the late Dr. Charles Hutton.

"He happily also struck out a new way to distinction and usefulness, by the discourses which were delivered by him, on the annual assignment of Sir Godfrey Copley's medal. This gentleman had originally bequeathed five guineas, to be given at each anniversary meeting of the Royal Society, by the determination of the president and council, to the person who should be the author of the best paper of experimental observations for the year. In process of time, this pecuniary reward, which could never be an important consideration to a man of an enlarged and philosophical mind, however narrow his circumstances might be, was changed into the more liberal form of a gold medal; in which form it is become a truly honourable mark of distinction, and a just and laudable object of ambition. No doubt it was always usual for the president, on the delivery of the medal, to pay some compliment to the gentleman on whom it was bestowed; but the custom of making a set speech on the occasion, and of entering into the history of that part of philosophy to which the experiments, or the subject of the paper related, was first introduced by Martin Folkes, Esq. The discourses, however, which he and his successors delivered, were very short, and were only inserted in the minute books of the Society. None of them had ever been printed before Sir John Pringle was raised to the chair. The first speech that was made by him being much more elaborate and extended than usual, the publication of it was desired; and with this request, it is said, he was the more ready to comply, as an absurd account of what he had delivered had appeared in a newspaper. Sir John was very happy in the subject of his first discourse. The discoveries in magnetism and electricity had been succeeded by the inquiries into the various species of air. In these inquiries, Dr. Priestley, who had already greatly distinguished himself by his electrical experiments, and his other philosophical pursuits and labours, took the principal lead. A paper of his, entitled, *Observations on different Kinds of Air*, having been read before the Society in March, 1772, was adjudged to be deserving of the gold medal; and Sir John Pringle embraced with pleasure the occasion of celebrating the important communications of his friend, and of relating with accuracy and fidelity what had previously been discovered upon the subject.

"It was not intended, we believe, when Sir John's first speech was printed, that the example should be followed; but the second discourse was so well received by the Society, that the publication of it was unanimously requested. Both the discourse itself, and the subject on which it was delivered, merited such a distinction. The composition of the second speech is evidently superior to that of the former one; Sir John having probably been animated by the favourable reception of his first effort. His account of the Torpedo, and of Mr. Walsh's ingenious and admirable experiments relative to the electrical properties of that extraordinary fish, is singularly curious. The whole discourse abounds with ancient and modern learning, and exhibits the worthy president's knowledge in natural history, as well as in medicine, to great advantage.

"The third time that he was called upon to display his abilities at the delivery of the annual medal, was on a very beautiful and important occasion. This was no less than Mr. (now Dr.) Maskelyne's successful attempt completely to establish Newton's system of the universe, by his *Observations made on the Mountain Schehallien, for finding its Attraction*. Sir John laid hold of this opportunity to give a perspicuous and accurate relation of the several hypotheses of the ancients, with regard to the revolutions of the heavenly bodies, and of the noble discoveries with which Copernicus enriched the astronomical world. He then traces the progress of the grand principle of gravitation down to Sir Isaac's illustrious confirmation of it; to which he adds a concise account of Messrs. Bouguer's and Condamine's experiment at Chimboraço, and of Mr. Maskelyne's at Schehallien. If any doubts still remained with respect to the truth of the Newtonian system, they were now completely removed.

"Sir John Pringle had reason to be peculiarly satisfied with the subject of his fourth discourse; that subject being perfectly congenial to his disposition and studies. His own life had been much employed in pointing out the means which tended not only to cure, but to prevent the diseases of mankind; and it is probable, from his intimate friendship with Captain Cook, that he might suggest to that sagacious commander some of the rules which he followed, in order to preserve the health of the crew of his ship, during his voyage round the world. Whether this was the case, or whether the method pursued by the captain to attain so salutary an end, was the result alone of his own reflections, the success of it was astonishing; and this celebrated voyager seemed well entitled to every honour which could be bestowed. To him the Society assigned their gold medal; but he was not present to receive the honour. He was gone out upon the voyage from which he never returned. In this last voyage he continued equally successful in maintaining the health of his men.

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[*] *Phil. Trans.* vol. xlvi. p. 480, 525, and 550.

[†] Id. vol. xlviii. p. 38.

[‡] Id. vol. xlviii. p. 497.

[||] Id. vol. li. p. 218.

[§] Id. p. 259.

" The learned president, in his fifth annual dissertation, had an opportunity of displaying his knowledge in a way in which it had not hitherto appeared. The discourse took its rise from the adjudication of the prize medal to Mr. Mudge, then an eminent surgeon at Plymouth, on account of his valuable paper, containing *Directions for making the best Composition for the Metals of Reflecting Telescopes, together with a Description of the Process for Grinding, Polishing, and giving the Great Speculum the true Parabolic form.* Sir John hath accurately related a variety of particulars, concerning the invention of reflecting telescopes, the subsequent improvements of these instruments, and the state in which Mr. Mudge found them, when he first set about working them to a greater perfection, till he had truly realized the expectation of Newton, who, above an hundred years ago, presaged that the public would one day possess a parabolic speculum, not accomplished by mathematical rules, but by mechanical devices.

" Sir John Pringle's sixth and last discourse, to which he was led by the assignment of the gold medal to myself, on account of my paper, entitled, *The Force of fired Gunpowder, and the Initial Velocity of Cannon Balls, determined by Experiments,* was on the theory of gunnery. Though Sir John had so long attended the army, this was probably a subject to which he had heretofore paid very little attention. We cannot, however, help admiring with what perspicuity and judgment he hath stated the progress that was made, from time to time, in the knowledge of projectiles, and the scientific perfection to which it has been said to be carried in my paper. As Sir John Pringle was not one of those who delighted in war, and in the shedding of human blood, he was happy in being able to show that even the study of artillery might be useful to mankind; and, therefore, this is a topic which he hath not forgotten to mention. Here ended our author's discourses upon the delivery of Sir Godfrey Copley's medal, and his presidency over the Royal Society at the same time; the delivering that medal into my hand being the last office he ever performed in that capacity; a ceremony which was attended by a greater number of the members than had ever met together before upon any other occasion. Had he been permitted to preside longer in that chair, he would doubtless have found other occasions of displaying his acquaintance with the history of philosophy. But the opportunities which he had of signalizing himself in this respect were important in themselves, happily varied, and sufficient to gain him a solid and lasting reputation.

" Several marks of literary distinction, as we have already seen, had been conferred upon Sir John Pringle before he was raised to the president's chair. But after that event they were bestowed upon him in great abundance, having been elected a member of almost all the literary societies and institutions in Europe. He was also, in 1774, appointed physician extraordinary to the king.

" It was at rather a late period of life when Sir John Pringle was chosen to be president of the Royal Society, being then 65 years of age. Considering therefore the great attention that was paid by him to the various and important duties of his office, and the great pains he took in the preparation of his discourses, it was natural to expect that the burthen of his honourable station should grow heavy upon him in a course of time. This burthen, though not increased by any great addition to his life, for he was only six years president, was somewhat augmented by the accident of a fall in the area in the back part of his house, from which he received some hurt. From these circumstances some persons have affected to account for his resigning the chair at the time when he did. But Sir John Pringle was naturally of a strong and robust frame and constitution, and had a fair prospect of being well able to discharge the duties of his situation for many years to come, had his spirits not been broken by the most cruel harassings and baitings in his office. His resolution to quit the chair arose from the disputes introduced into the Society, concerning the question, whether pointed or blunted electrical conductors are the most efficacious in preserving buildings from the pernicious effects of lightning, and from the cruel circumstances attending those disputes. These drove him from the chair. Such of those circumstances as were open and manifest to every one, were even of themselves perhaps quite sufficient to drive him to that resolution. But there were yet others of a more private nature, which operated still more powerfully and directly to produce that event; which may probably hereafter be laid before the public, when I shall give to them the history of the most material transactions of the Royal Society; especially those of the last twenty-two years, which I have from time to time composed and prepared with that view.

" His intention of resigning, however, was disagreeable to his friends, and the most distinguished members of the Society, who were many of them perhaps ignorant of the true motive for it. Accordingly, they earnestly solicited him to continue in the chair; but, his resolution being fixed, he resigned it at the anniversary meeting in 1778, immediately on delivering the medal, at the conclusion of his speech, as mentioned above."

The late Sir Joseph Banks succeeded Sir John Pringle in this high office, and continued during his long and active life to discharge its important duties.

In consequence of the declining state of his health, Sir John undertook a journey to Scotland, and he spent the summer of 1780 and 1781 in Edinburgh. During this visit he presented to the Royal College of Physicians of that city, TEN Folio volumes of *Medical and Physical Observations,* in MS. on the condition that they should neither be published nor lent out of the library of the college.

On his return to London he continued in a weak state of health till the 18th of January, 1782, when he died in the 75th year of his age. He was interred in St. James's church, and a monument was erected to his memory in Westminster abbey, by his nephew and heir Sir James Pringle, Bart. of Stitchel. For farther particulars respecting this eminent individual, see Dr. Kippis's Life of Sir John Pringle, prefixed to his six discourses; and Dr. Hutton's elaborate memoir of his life, in the *Mathematical Dictionary,* vol. ii. p. 279.

Definition.

PRINTING, a term susceptible of several slight shades of meaning, is used in this article as denoting the art of making impressions of figures, characters, letters, with ink, upon paper, vellum, or any similar substance; or, in other words, as expressing that mechanical process by which any piece of literary composition, written in any language or dialect, is converted into a book by means of types, ink, paper, &c.

Printing known in China at a very early date.

This art, though unknown in Europe till towards the middle of the fifteenth century, was practised in China at an extremely remote period. The Chinese mode of printing, however, as explained below,* was considerably different from that used by Europeans. It was indeed characterised by almost insuperable disadvantages. Yet that country, while Europe was involved in the ignorance and barbarism by which the middle ages were distinguished, had the honour of exercising an art, which presupposes no mean degree of refinement, and which, more than any other circumstance, has the effect of promoting the progress of literature and liberal knowledge. At what period printing was invented in China, it is impossible to ascertain. This invention has been ascribed by some writers to an age prior to the time of our Saviour; others have referred it to an era somewhat less remote; but, amid the diversity of opinion, it seems to be denied by none, that it was fully established early in the tenth century,—five hundred years ere it had, in the slightest degree, been contemplated in Europe.

Invention in Europe.

But printing, though thus early known in China, was not introduced thence into Europe. The Europeans had the honour of inventing this art for themselves, ere the passage to the East by the Cape of Good Hope was discovered, and of course ere they had any knowledge even of the existence of that distant country. This fact none has ventured to call in question; but the circumstances connected with the origin of printing in Europe cannot be so satisfactorily explained.

Claimed by three cities.

Three cities, Harlaem, Ments, and Strasburg, have severally laid claim to this distinction. Each of them can produce a greater or less body of evidence; but which of them is supported in the most conclusive manner, it has not hitherto been found very easy to determine. Our opinion is decidedly in favour of Harlaem; yet it must not be denied that the cause of the other two cities respectively have been warmly espoused by various distinguished writers, and that one of them, (Ments) if not entitled to the honour of the invention, contributed not a little to the progress and perfection of the art. In the present article, we shall state impartially the prominent facts in support of the different places, without bringing forward all the minute and frivolous statements and objections with which this investigation has been needlessly encumbered.

Claims of Harlaem.

The claims of Harlaem deserve to be first considered. That Laurentius Coster of that city (so called from his father's holding the office of *Custos* of the cathedral) was the inventor of the art of printing, is supported by evidence that no candid inquirer can resist. The first celebrated writer who (in 1588) espoused the cause of Laurentius, was Hadrian Junius, an author of authenticity, whose narrative is given on the authority of two respectable persons, Nicolaus Galius, and Quirinus Talesius. Talesius, amanuensis to the great Erasmus, and a very eminent citizen of Harlaem, had every opportunity of acquiring an exact knowledge of the art in question, as he was acquainted with the descendants of Laurentius, and as he must have known many of the contemporaries and friends of that celebrated individual. Galius, who was the teacher of Junius, substantiates his account by the testimony of Cornelius, formerly servant to Laurentius, and afterwards bookbinder to the cathedral. The work of Junius, satisfactory as it is, is not however unsupported by other writers. Mr. Meerman of Rotterdam, in particular, who has followed him in the same line of investigation, has fully corroborated his opinion; and from the many important facts Mr. Meerman has elicited, and from the specimens he has given of the rude typography of Laurentius, his *Origines Typographicae* cannot fail to interest the curious reader. Nor do these writers stand alone. The claims of Laurentius had been acquiesced in and enforced, even before the time of Junius, by various writers,—by Zurenus, Coornhertius, Pantaleon, Guicciardini, Ulrig Zell. The testimony of Zell is peculiarly valuable; for though, being a German, he must have felt inclined to ascribe, if possible, the honour of this invention to Ments, he yet had the candour to give his opinion in favour of Harlaem. From the foregoing statements, and various others as satisfactory might be adduced, it is extremely probable, if not absolutely certain, that Laurentius of Harlaem had the honour of being the inventor of that art, the history of which we are endeavouring to trace, and which has been productive of incalculable advantages to mankind.

Inventions, fraught with the most important consequences to the world, have as often been the result of accident as of ingenuity. This remark is applicable with peculiar emphasis to the art which we are now contemplating. "Laurentius," says Junius, "walking in a wood near the city, began at first to cut some letters upon the rhind of a beech-tree; which, for fancy's sake, being impressed on paper, he printed one or two lines as a specimen for his grandchildren to follow. This having happily succeeded, he meditated greater things (as he was a man of ingenuity and judgment;) and first of all with his son-in-law, Thomas Peter, invented a more glutinous writing ink, because he found the common ink sunk and spread; and then formed whole pages of wood, with letters cut upon them; of which sort I have," continues Junius, "seen some essays in an anonymous work, printed only on one side, entitled *Speculum Nostrae Salutis*; in which it is remarkable, that in the infancy of printing, (as nothing is complete at its first invention) the back sides of the pages were pasted together that they might not by their nakedness betray their deformity."

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* The Chinese mode of printing, which has undergone no essential alteration from the most distant periods, was as follows: They take blocks of wood, firm, close, and smooth, of the size and form of the page they mean to print; on the one side, they glue a paper, on which some able penman delineates the necessary letters and characters; the wood in this state is put into the hands of a sculptor, who, following with the proper instruments the outlines of the characters inscribed on the paper, cuts them out in relievo; the paper is then gently rubbed off; and the engraved tablet, thus prepared, is that by which their printing is executed. Of this plan, the disadvantages are manifest. There must be as many blocks as there are pages in a book; these blocks are not of the least use in printing any other works; and, besides, the process is extremely tedious and expensive. In opposition to these disadvantages, however, the Chinese, it may be mentioned, require no corrector of the press; their books are uncommonly accurate and beautiful; and they are not required to throw off a whole edition at once, but as they require them. Their paper and ink, however, being bad, their books soon decay, and nothing that deserves the name of an old book can be found in all China.

At what period printing was thus accidentally invented has not been exactly ascertained. Laurentius died in 1440. He published the *Speculum Nostrae Salutis*, as stated above, and two editions of Donatus; and the "specimen" mentioned in the foregoing extract has been discovered to be a *Horarium*, containing the letters of the alphabet, the Lord's prayer, the Apostles' creed, and three short prayers, in all only eight pages. These works, considering the difficulties Laurentius had to encounter, and that they were all printed with separate wooden types fastened together with thread, must have required years in the execution; and it has thus been conjectured that the invention took place about or soon after 1430. Laurentius, however, though we allow him the honour of the invention, cannot be regarded as having brought the art to any high degree of improvement.* On the contrary, the few works which he printed, are remarkable only for rudeness and inelegance. The pages are not numbered; there are no divisions at the end of lines; no direction-words; and in the Horarium, his most clumsy performance, there is no punctuation; the lines are uneven; and the pages are not always of the same size or shape. Engravings of this rude typography may be found, as already mentioned, in the celebrated work of Meerman, to which we beg leave particularly to refer.

The city of Mentz, which next demands our attention, can lay no claim, if the above reasoning be correct, to the invention of printing. This distinction, indeed, can with no degree of plausibility be attributed to any other place than to Harlaem. But it must not be denied that Mentz made many important improvements in the art: though it must, at the same time, be confessed that the knowledge of it was transferred thither in a way that reflects honour neither on the city, nor on the person by whom that knowledge was introduced. Mentz is indebted for the introduction of printing, not to the ingenuity of any of her citizens, but to the knavery of one of the servants of Laurentius, who, emulous of the honour which, on account of this invention, his master enjoyed, and the wealth which his new profession promised to yield him, on Christmas eve, when Laurentius and his family were engaged in the exercises of religion, basely stole the types, and all the necessary apparatus, and, with an accomplice, after visiting Amsterdam and Cologne, settled at Mentz in the capacity of a printer. Who this dishonest servant was, has been a question much agitated. That his name was John, has been allowed by all writers, and Mr. Meerman seems to have at last ascertained that it was John Geinsfleisch, probably a native of Mentz, who, both on account of his knavery to his master, and his subsequent eminence as a printer, occupies a prominent place in the annals of typography. Geinsfleisch, on his arrival in Mentz, lost no time in availing himself of the implements he had so dishonourably brought along with him; for in 1442, within two years from the time he absconded from Harlaem, he published two little works, the Doctrinale of Alexander Gallus, and the Tracts of Peter of Spain, which, being both used as school-books, met, it is probable, with a rapid sale.

But Geinsfleisch, long a servant, had not, as may be supposed, wealth sufficient to carry on his profession to any great extent; the profession, however, was honourable, and promised to become so lucrative, that a person of the name of John Faust, a wealthy citizen, willing to advance money, acquired a share of the business in 1443. Meidenbachius, and others, were also about the same time admitted as partners; and in 1444, Guttemberg, of whom we shall soon speak more fully, supposed to be the brother of Geinsfleisch, removed thither from Strasburg, where he had long resided. Geinsfleisch being thus patronised and supported, an improvement was made in the art of printing which has conferred immortality on those by whom it was effected, and which, in point of utility, is inferior only to the original invention. The insufficiency of wooden types, particularly their want of durability, must have been deeply felt. With such materials, indeed, printing must have been an extremely tedious, clumsy, and expensive operation; and Geinsfleisch, with his brother Guttemberg, thus instigated to attempt improvements, had the merit of being the first that devised and used *cut metal* types. This was a most important step in the progress of the art,—and something far greater than had yet been accomplished might now be expected. While these metal types were preparing, a task of no ordinary labour, several small books, chiefly for the use of schools, issued from the Mentz press; and the first result of the new invention was an edition of the Bible, which, taking seven or eight years to execute, was published in 1450, and which, for accuracy and beauty, would do honour to the art at any stage of its history.†

A revolution now took place (1445) in the printing establishment at Mentz. The partnership was dissolved. Geinsfleisch, now dim-sighted with age, seems to have retired from business, though he survived till 1462. A new partnership was formed between Faust and Guttemberg, which, however, from some misunderstanding, was soon terminated; and Faust, with Peter Schoeffer, a native of Gensheim, whether as a partner or assistant is not well known, continued to carry on the business. In 1457 an edition of the Psalter was published by them, remarkable for its elegance, but chiefly distinguished as the first book printed with a *date*. From this time, however, not only were the dates given, but the name of the printer, and the town where the work was executed. Guttemberg, it may not be improper to mention, though separated from Faust, did not remain long unemployed. He found a patron in Conrad Humery, Syndic of Mentz, through whom he opened another printing-office in that city, from which issued several elegant works. His merits acquired him the notice and friendship of the Elector Adolphus, from whom he received a pension; and, after a life of great activity and enterprise, he died in 1468.

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* Laurentius, who at the time of his death is supposed to have been seventy years of age, was succeeded as a printer either by Thomas Peter, his son-in-law, married to his only daughter Lucia, or by their children Peter, Andrew, and Thomas. What works they printed cannot be exactly determined, as they prefixed to their books neither date nor names. They are, however, known to have executed, with others specified by Mr. Meerman, various editions of the *Donatus* and *Speculum*, of which many copies yet remain. The last book they are said to have printed, was an edition of the works of Thomas à Kempis, in 1472; soon after which period, having disposed of all their materials, they relinquished the profession. They did not attain to great eminence; for though their works are executed in a style considerably more elegant than those of Laurentius, they made use of nothing but separate wooden types; nor do they seem ever to have heard of the important improvements in the art accomplished at Mentz. Peter and Andrew, the two eldest grandsons of Laurentius, perished in the civil wars of 1462.

† It was not the first edition of this Bible, but the second, more beautiful and expensively printed in 1462, copies of which Faust sold in Paris as *manuscripts*. The price he at first obtained was from 500 to 600 crowns, though he was afterwards obliged to be content with sixty, and at length with forty. The Parisians, who regarded this Bible as executed by magic, and who were not till some time after the period in question acquainted with the art of printing, atoned for this ignorance, by producing, in the subsequent century, Henry, Robert, and Henry Stephens, the most learned and celebrated printers that have yet appeared in Europe,—men by whom the progress of classical literature was more promoted than by any other individuals.

In the art of printing, however, though it had made great progress, an important improvement was yet to be made ere the invention could be regarded as complete. And Peter Schoeffer, of whom we have just spoken, was destined to have the honour of filling up this desideratum. Naturally ingenious and inquisitive, Schoeffer discovered, after repeated trials, that the letters might, by means of a matrix, be *cast*, instead of being cut. Ere he revealed this discovery to any, he privately made matrices for the whole alphabet, and "when," as we are told, "he showed his master the letters cast from these matrices, Faust was so pleased with the contrivance, that he promised him his only daughter in marriage; a promise which he soon afterwards performed." This invaluable discovery, which was made about 1458, forms one of the most remarkable epochs in the history of printing; and so much and so rapidly did it facilitate the art, that Schoeffer, before his death, which is supposed to have taken place about 1492, or the following year, printed upwards of fifty works. Of these the most celebrated are two editions of Cicero *de Officiis*, some copies of which are yet to be seen in our public libraries. Schoeffer and Faust seem to have used only one size of cast letters, as all the large characters in the body of their books, and at the top of the pages, were made from cut types. They at first also seem to have printed on vellum, in preference to paper, a practice soon laid aside; and a few copies only were afterwards printed on vellum as curiosities, or for the purpose of being brilliantly illuminated.*

Such, as it seems to us, are the claims which Mentz possesses to the invention of printing. The art was first known and practised at Harlaem, but Laurentius and his family made use of nothing but wooden types, and the books which Laurentius printed, though not very inaccurate, are clumsy and inelegant. Mentz, therefore, has the honour of bringing the art to perfection. It discovered and introduced the advantages of metal types, first cut and then cast, and is inferior to Harlaem only in as far as the inventor of any art is superior to him who accomplishes improvements on what is already known, or who makes it more easily applicable and useful. It must not be denied, however, that in the edition of the Psalter published in 1457, Faust and Schoeffer assume to themselves the merit of a new invention; but this, we think, has reference only to metal types, as they themselves very indirectly allow that printing had been before known, and that they had merely gained an important, and previously unknown step, in the progress of it. And it is extremely improbable, had they really been the original inventors of the art in question, that they would have delayed urging their claims to this distinction (since they urged them at all) till the year 1457, since they might have done so with equal, or rather far greater, propriety fifteen years before that period.

The claims of Strasburg come next to be considered,—a task by no means difficult to perform. Guttemberg, who, as formerly mentioned, originally resided at Strasburg, (where his ordinary profession was that of a looking-glass maker, and a polisher of precious stones,) and who afterwards joined his brother Geinsfleich at Mentz, is the person whom Strasburg holds out as the inventor of printing. It has been supposed, that, having paid a visit to his brother at Harlaem, Guttemberg, in this way, became acquainted with the success of Laurentius, and that, on his return to Strasburg, he exerted his utmost ingenuity to put into practice the knowledge thus obtained. How far this opinion is correct cannot now be established; but it is distinctly proved by Mr. Meerman that all his efforts were ineffectual,—a fact which, were it evident from nothing else, is evident from the circumstance of his afterwards removing to Mentz; for had he been established as a printer in Strasburg, it is highly improbable he would have left a place where his merits must have been so thoroughly known, and where, carrying on business on his own account, he must have been far more successful and prosperous, than as assistant and partner to his brother at Mentz. Even Wimphelingius, the earliest writer in favour of Strasburg, admits in his *Epitome Rerum Germanarum*, that the art of printing was found out *incomplete* by Gutenberg, and that he was not altogether acquainted with it till he had settled at Mentz. And what is indeed a stronger and more irrefragable argument, no writers who support Guttemberg ever speak of any book *printed* by him. Nor, indeed, is there any proof of a single volume printed at Strasburg till after the year 1462, a period when, as shall soon be shown, the art was introduced into most of the principal towns in Europe. Guttemberg, it may be mentioned, was a man of ingenuity and talents, but a fanciful theorist and projector; and his speculations had been so absurd or unprofitable that, on his removal to Mentz, he was in a state of insolvency, and was obliged to dispose of his little property to lessen or liquidate his debts.

But the supporters of Strasburg, convinced that the arguments in favour of Guttemberg are inconclusive, or anxious to proclaim the praise of another individual, have brought forward another candidate for the honour. Metelius, the person thus distinguished, was, it is not denied, the first that was established in that city as a printer; but whatever assertions may have been made, there is no proof that he published any works before 1462 or 1463, previously to which date the art had not only been practised twenty years at Mentz, but had been brought to a high state of improvement. The claims of Metelius are supported by little or nothing deserving the appellation of evidence. These claims were first published to the world by Schottus, a grandson of Metelius, likewise a printer at Strasburg, a person to whose word, in such a case, we cannot attach the most implicit confidence, and who rested his opinion on the circumstance that the Emperor Frederick III. had granted him, as the descendant of the inventor of printing, the privilege of wearing a coat of arms, descriptive of his honourable descent. This assertion is totally false and unfounded. The art, in question, soon attained the most illustrious patronage. Guttemberg was made a counsellor of state by the Elector Adolphus, and was distinguished by an annual pension; the Emperor Maximilian secured to Schoeffer the exclusive right of printing Livy; and Frederick III., instead of conferring exclusive privileges on Metelius, granted the same privileges to printers in every part of his dominions. "Typothetis scil. aquilae, typographis autem gryphi, pede altero pilam tinctoriam unguibus tenentis, scutum donavit, cum aperta galea et superimposita ei corona."—An old chronicle of Strasburg in favour of Metelius has also been triumphantly quoted. The authority of this paper, however, (at best but doubtful,) has been completely destroyed by the contrary authority of a similar document at Cologne, as well as by Wimphelingius and various other writers.

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* Schoeffer, as previously mentioned, died about 1492; but how long Faust lived is unknown; his death, however, must have taken place before 1471, as at that time Schoeffer, his son-in-law, was in partnership with Conrad Henlif.

Such are the claims of these cities to the invention of printing. We have investigated their several pretensions to this honour, with the most rigid impartiality. And from the discussions in which we have been engaged, it is evident, we think, *first*, that the art of printing was invented and first practised in Harlaem; *secondly*, that the knowledge of it was early introduced thence into Mentz, where it was assiduously cultivated, improved, and brought nearly to that state in which we now find it; and, *thirdly*, that the claims of Strasburg, being unsupported by evidence, seem to be entirely false. These points being established, the remainder of this article shall be employed in tracing the progress of the art in various quarters of the world till its introduction into England and Scotland.

Faust and Schoeffer, when they had made the important discovery of casting the types in a matrix instead of cutting them, afraid that the knowledge of this improvement might become public throughout Europe, and prevent that monopoly which they expected to secure to themselves, administered an oath of secrecy to all their workmen. The precaution might well have been spared. For, Mentz having been sacked by the Archbishop Adolphus in 1462, their servants were dispersed into different countries, and carried with them the knowledge they had acquired under their former masters. From this period printing made rapid progress in most of the principal towns in Europe. It had, even before the sacking of Mentz, been introduced into Bamberg in Franconia; and in the national library of Paris there is part of a Bible in German, in large Gothic characters, published at Bamberg in May 1462, and executed with metal types as improved by Schoeffer. In 1465 the art had reached Naples, for, in that year, Lactantius's *Institutes* were printed in Monasterio Sublacensi in that kingdom. Conrad Sweynheim and Arnold Pannartz, names familiar to every reader, settled in Rome in 1467; men whose passion for multiplying books, or rather whose zeal in the cause of letters, induced them to carry on their profession to an extent that involved them in ruin and in poverty.* In 1472, Theodore Martens established himself at Alost in Holland. About this time also the art had become known in Venice, Milan, Bern, Antwerp, and all the important cities of the Continent. In 1490, it had reached Constantinople, and, according to Mr. Palmer, it had extended, by the middle of next century, to Africa and America. It was introduced into Russia in 1560; but, from the most illiberal and mistaken motives, it was soon suppressed; nor did it, till the time of Catherine II., experience, in that country, any favour or patronage. Printing, however, soon found its way even into countries more barbarous and inhospitable than any we have yet considered: for Mr. Bryant (*Observations and Inquiries relating to various parts of Ancient History*, p. 277,) proves that a work written by a native of Iceland was printed in Hola in that island so early as 1612. "I believe," says he, "it is the farthest north of any place where arts and sciences have ever resided."

For thirty years after the invention of printing, the uniform character was the old Gothic or German, whence our black was afterwards derived. The *Roman* type, as now used, was introduced by Sweynheim and Pannartz of Rome, in an edition of Cicero's *Epistolæ Familiares*. The *Italic* character was, at a subsequent period, invented by the celebrated Aldus. The first printed books were either in Latin, or in the language of the respective countries in which they were published.

Greek printing.

The first attempts at Greek printing took place in a few sentences, very rudely executed, which occur in the famous edition of Cicero *de Officiis* by Schoeffer, in 1465. Various attempts of a similar kind, though considerably more successful, were made about the same time by other enterprising printers; but the first complete Greek work yet discovered, is a grammar of that language by Lascaris, printed at Milan in 1476; and, to overlook various minor attempts at Greek printing, a splendid edition of Homer issued, in 1488, from the press of Demetrius of Florence, a native of Crete. Works in this tongue were rapidly multiplied; but the first Greek edition of the Bible printed at Complutium, was not finished till 1517. It was not, however, published till five years afterwards, and therefore the edition of Venice in 1518 may be regarded as having preceded it. The Greek Psalter had often been printed before this time. And Erasmus had published a Greek edition of the New Testament in 1516. Aldus has been by some reckoned the first Greek printer; but though this opinion, as is evident from the foregoing statements, is incorrect, yet Aldus, it must be allowed, for the beauty, correctness, and number of his works in that language, far eclipsed his most distinguished predecessors, and earned a name known wherever letters are cultivated.

Hebrew printing.

Nor in the mean time was the Hebrew language overlooked. The Pentateuch was printed so early as 1482; and afterwards at short intervals, the prior prophets, the posterior prophets, and the Hagiographa, the whole terminating in 1487. And in the subsequent year the whole New Testament was published, with vowel points, in one volume folio, at Soncino, duchy of Milan, by a Jewish Rabbi. The first Polyglot Bible was printed at Genoa in 1516, by Porrus, containing versions in Hebrew, Arabic, Chaldaic, Greek, Latin.†

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* In a petition for assistance and relief addressed (1472) by these printers to the Pope, "We were the first of the Germans," they say, "who introduced this art with vast labour and cost into your holiness's territories in the time of your predecessor; and encouraged, by our example, other printers to do the same. If you peruse the catalogue of the books printed by us, you will admire how and where we could procure a sufficient quantity of *paper*, or even of *rags*, for such a number of volumes. The total of these books amounts to 12,475, a prodigious heap, and intolerable to us, your Holiness's printers, by reason of those unsold. We are no longer able to bear the great expence of house-keeping for want of buyers; of which there cannot be a more flagrant proof than that our house, though otherwise spacious enough, is full of *quire-books*, but void of every necessary of life." (Palmer's *Hist. of Printing*, p. 130.)

† In the early history of the art of printing, the most learned men were proud to act as correctors of the press; and printers not unfre-

Introduction of printing into England. William Caxton.

Having thus traced the progress of printing in different parts of the world, we must now endeavour to ascertain its introduction into Britain. That William Caxton, who established a press in Westminster Abbey in 1471, was the first printer in England, was universally believed until about a hundred and fifty years ago, when a small work was discovered in the public library of Cambridge, printed at Oxford in 1468. Of this work, which consists of 41 quarto leaves, the title is *Expositio Sancti Jeronimi in Simbolum Apostolorum ad Popam Laurentium;* and at the end the date is explicitly given, *Impressa Oxonii, et finita Anno Domini* M.CCCC.LXVIII. XVII. *die Decembris.* The genuineness of this date is authenticated by a curious document, which, till the middle of the 17th century, had lain obscure and unknown in the register of the see of Canterbury, and which was given to the world in 1664 by Atkyns in "The Original and Growth of Printing." In this document it is mentioned, that a report of the invention of printing having reached England, Henry VI. at the suggestion of Bourchier, archbishop of Canterbury, anxious to obtain for his subjects the advantages of this art, appointed Robert Tourner (who took with him William Caxton) to go to Holland to procure a "printing mould:" that Frederick Corsellis, one of the under printers at Harlaem, was either bribed or forced to leave his former master, and remove to England: that Corsellis, who brought with him some types, was established at Oxford; but that as Oxford was found to be too far distant from London, a press was set up at St. Albans, and another soon after at Westminster. Such is the evidence upon which Caxton has been of late years denied the distinction he had so long enjoyed. That it is conclusive we will not pretend to determine. Most writers, as Anthony Wood, Maittaire, Palmer, &c. have been convinced by it; while Dr. Middleton has endeavoured to show that it is unsatisfactory and doubtful. But though we allow it to be decisive, (at least it is impossible to establish the contrary,) the fame of Caxton is but very slenderly affected by it. For though priority in point of time be granted to Corsellis, yet that printer, and those whom he instructed, used nothing but separate wooden types similar to those of Laurentius at Harlaem; and Caxton possesses the honour of having been the first that introduced the use of metal types as invented at Mentz, and of otherwise bringing the art to great perfection in England. The first book that Caxton printed was a translation of the Æneid, written by himself, and entitled *The Recuyel of the Historyes of Troye.* He published a great number of works; among others an edition of Æsop's Fables, a copy of which is still preserved in the Bodleian library, regarded as the first that had its leaves numbered. Caxton is entitled to commemoration, both on account of his eminence as a scholar and a printer, and of his integrity and worth as a man. His master Robert Large, a mercer in London, with whom Caxton served his apprenticeship, entertained so great a respect for him, that he left him a legacy at his death. After his master's death (1441) he spent the subsequent thirty years on the Continent in the business of merchandise, and in the cultivation of his mind, naturally vigorous and inquisitive. And it may be mentioned, as a proof of the respectability of his character, that he was employed by Edward IV. jointly with Richard Whitehill, Esq. to transact and conclude a treaty of commerce between that monarch and his brother-in-law the Duke of Burgundy. It is gratifying to know, that, on his return to England, he met with the honour and notice he deserved. Most of his works are inscribed either to the king or to some of the royal family; and he enjoyed the friendship of the nobility and eminent men of his day. He attained to a very venerable old age; for though so early as the year 1471, he complained that "myn hande is wery and myn eyen dimmed with overmoche lokyng on the whit paper, and that age crepeth on me dayly," he yet survived that period twenty years, and died in 1491. He was succeeded by Richard Pynson and Wynkin de Worde, two of his principal workmen. John Letton and William Machlinia had indeed settled as printers in London before his death; but neither they nor any for many generations rivalled the fame and success of Caxton. The art, however, was patronized, and flourished in no ordinary degree; and in the reign of Henry VII. and his successor, English printers, we are told, had become "so skilful, as to print books as well as any beyond the seas."

Printing was not introduced into Scotland till upwards of thirty years after Caxton had settled in London. The first Scottish printers were Walter Chapman, a merchant in Edinburgh, and Andrew Millar, a mere workman, who, in consequence of a patent from James IV. established a press at Edinburgh in 1507. "In 1508," says Dr. Irving, "they are known to have printed various pamphlets; a collection of which may be found in the Advocates Library. The first volume of the *Breviarium Aberdonense* issued from their press in 1509; the second in 1510.—Of this very rare book, a complete and well-preserved copy belongs to the library of the university of Edinburgh. The establishment of printing presses in the other principal towns of Scotland cannot so easily be traced. Knox's *Faythfull Admonition unto the Professours of God's Truthe in England* was, if we may credit the title-page, printed at *Kalykow* or Kelso. This work appeared in 1554. Aberdeen, the seat of a university, could not boast of a printing-press till a much later period. In the colophon of a poem (1635) on the death of Bishop Forbes, Edward Raban styles himself *Master printer, the first in Aberdene.*" But though printing was thus established in Scotland, many of our most eminent Scottish productions were printed on the Continent; as for example, those of Mair, Boethius, and Bishop Lesley. Scotland, however, had the honour of ushering into the world two of the most celebrated and classical works of which modern literature can boast, *De Jure Regni apud Scotos,* written by Buchanan, and the *History of Scotland* by the same illustrious author.

Neither Chapman and Millar, nor any of their successors for many ages, were distinguished, like many of the printers of that period, for literary attainments. "At the commencement of the seventeenth century," says Mr. Chalmers, "the printers of Edinburgh were generally booksellers, who, having acquired some

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quently added on the title-page the name of the corrector to their own. The first letter of a chapter was often not printed, but a blank left, that it might be painted or illuminated according to the taste of the purchaser. Books of all kinds, particularly prayer-books, were embellished with cuts, often inappropriate or ludicrous, but always executed in an elegant style. A work on natural history is mentioned, in which the Deity is represented as *reading* on the seventh day, when he rested from all his works. (*Vide* the works of Palmer, Maittaire, &c.)

wealth, could purchase a press, and employ artificers; but knew no more of books than the title-page and the price. Andro Hart, who is justly praised by Watson for his well-printed Bible, was only a bookseller." But this deficiency is amply compensated by the critical acumen and erudition of Ruddiman, (not to mention one or two others,) to whom, in this island, classical literature is more indebted than to any other individual. "Henry Stephens himself," says Mr. Chalmers, "would have scarcely complained of Ruddiman as one of those printers who had brought the typographic art into contempt by their illiterature. When we recollect his *Gawin Douglas* and *Buchanan*, his *Rudiments* and his grammars, his *Livy*, and his *Vindication of Buchanan's Psalms*, wherein competent judges have found the knowledge of a scholar and the accuracy of a critic, we may fairly place Ruddiman in the honourable list of learned printers, with Badius and Aldus, with the Stephenses and Jansens."

But though, in general, Scotland may not have attained to great eminence in the history of printing, there is yet one species of the art of which she is entitled to the honour of the invention. We allude to *Stereotype* printing, invented by William Ged, first a goldsmith, and afterwards a printer in Edinburgh. The word is obtained from the Greek terms στερεος solid, and τυπος a type, as the method which it designates consists in printing from solid plates instead of moveable types. The mode of casting stereotype it may not be improper to mention. The work to be stereotyped requires to be set up by the compositor in distinct pages. From the several pages, when carefully corrected, a mould in plaster, the basis of which is gypsum, is taken,—and from this mould an impression is cast, forming an exact fac-simile of the moveable types originally set up by the compositor. A stereotype plate is thus obtained, and the great saving of expence consists in this, that the stereotype plate does not require to be above one-seventh part the breadth or thickness of the ordinary types. This mode of printing combines many advantages, such as security against typographical errors, and cheapness of execution. It can, of course, only be used in the printing of books that are in general use, and require no alteration or correction, as the original expence of casting the plate would be too high for a work of limited circulation, undergoing probably only one edition. But in publications of steady and ordinary sale, as prayer books, Bibles, school books, the saving is not less than 40 per cent. The invention of this mode of printing is due to William Ged as above mentioned. France and Holland have, it is true, respectively laid claim to this honour; but their pretensions are so inadequately and flimsily supported, that all writers have now concurred in favour of our countryman. Mr. Ged, naturally inquisitive and ingenious, had made, while a goldsmith, various improvements in the line of his profession; and was led to turn his attention to printing, as he himself informs us, in the following manner. In 1725, conversing with a printer on the disadvantages experienced in Scotland from the want of a letter foundry, and thence adverting to the inconveniencies of single types, and the tediousness and expence of putting them together in pages, the printer, aware of the mechanical eminence of Ged, asked him if it was not possible to remedy so great and palpable a defect. "I answered," (says Ged) "that I judged it more practicable for me to make plates from the composed pages than single types. To which he replied, that if such a thing could be done, an estate might be made by it. I desired he would give me a page for an experiment, which, after some days trial, I found practicable, and so continued for near two years, improving on my invention, and making a great many experiments, several of which were expensive: but the more I practised, and the less chargeable materials I used, I was the more successful, till at last I brought it to bear as that no distinction could be made between the impression from my plates and that from the types." (*Memoirs of Ged*, p. 1.)

Such was the invention of Ged; and nothing prevented him from carrying it into immediate and extensive effect but the want of capital. A gentleman of Edinburgh undertook, on condition of getting a fourth of the profits, to advance the necessary funds; but the other printers thinking that if Ged's invention were acted upon, their business would be ruined, dissuaded the person in question from furnishing the requisite sum, assuring him that his whole fortune would be insufficient to accomplish the undertaking. In two years, accordingly, L.22 was all that was advanced; and Ged, thus disappointed in Edinburgh, accepted the offer of a London stationer to remove to that city to carry his wishes into effect. In the English capital his objects were, as before, opposed by the jealousy of trade, particularly by the exertions, (whether honourable or otherwise, we shall not say,) made by the King's Printers, whose interests they supposed were at stake. Mr. Ged returned to Edinburgh in 1739, where, owing to the liberality of his friends, he printed a stereotype edition of Sallust, in 150 pages, 12mo. with this curious title, *C. Crispi Salustii Belli Catilinarii et Jugurthini Historiae. Edin. Gulielmus Ged, Aurifaber Edinensis, non typis mobilibus ut vulgo fieri solet, sed Tabellis seu Laminis fusis excudebat, MDCCXXXIX.* In the execution of this work he met with the most marked opposition. No compositor could be got to set up the types, from which the plate was to be taken; and his own son, a boy of only twelve years of age, then an apprentice to a printer, did this part of the process at night, or during his intervals of labour. Another small work, Scougal's *Life of God in the Soul of Man*, was executed by Mr. Ged,—who died in 1749, after having devoted nearly thirty years of his life to the improvement of an art of great public importance, but which to him or his family was never productive of any advantage. He left behind him two sons, who emigrated to Jamaica, where they both died. And his name, and the services he had rendered to a useful art, were nearly forgotten till Mr. Nichols published *Biographical Memoirs* of him in 1781, and till Mr. Alexander now Dr. Tilloch, (also a Scotchman,) the editor of the *Philosophical Magazine*, did ample justice to his merits in the tenth volume of that journal. Dr. Tilloch may himself be regarded as the second inventor of stereotype printing; for having bestowed great attention on the art in question, he discovered the practicability and utility of solid plates ere he had heard of the original invention. Within the last forty years, many improvements have been made in the stereotype printing, particularly by Dr. Tilloch and Mr. Foulis of Glasgow, several French printers, particularly Hoffmann and the two Didots, Mr. Wilson of London, Earl Stanhope, &c. It is now gaining ground every day, and promises to be productive of incalculable advantages.

Dr. Tilloch.

See the following works on this subject: Junius's *Batavia*, Lugd. Bat. 1588. Maittaire's *Annales Typographicæ*. Meerman's *Origines Typographicæ*. *Histories of Printing*, by Watson, Palmer, Marchant. An excellent synopsis of the discussions of former writers may be found in *The Origin of Printing, in two Essays*, &c. Lond. 1774, 8vo. See also Chalmers's *Life of Ruddiman*, pp. 80, 81. Irving's *Lives of the Scotish Poets*, vol. i. p. 75. *Memoirs of Ged.* (T. M.)

PRINTING PRESS, is a well-known machine for printing books, which at an early period of the art was brought to a considerable degree of perfection. Although the name of the inventor of the printing press has not been handed down to us, yet it is known to have received great improvements from William Janson Blaew, who had been an assistant and instrument maker to Tycho Brahe, and who established a printing office at Amsterdam, where he printed several books of maps from the observations of that celebrated astronomer. Till within the last fifty years, the common printing press remained in its original state; but since that time, the progress of improvement has been extremely rapid, and many most material additions and changes have been made upon it. The introduction of printing machinery, too, has formed a new era in this art, and it is highly probable that, in very large establishments, the use of the ordinary printing press will be entirely superseded by that great invention. In giving an account of these improvements, we shall begin with the common printing press.

Common Printing Press.

Common printing press. PLATE CCCCLXVIII. Fig. 1.

A perspective representation of this press is given in Plate CCCCLXVIII. Fig. 1. The body of the press consists of two *cheeks*, or strong vertical posts A, A, bound together by four horizontal bars. The first of these bars B is called the *cap*, and merely keeps the parts at a proper distance. The second cross bar C, called the *head*, is fitted by tenons at the ends into mortices between the cheeks; and the bar admits of a small motion, or play, in consequence of the mortices being filled up with pieces of pasteboard or soft wood. The head C is suspended from the cap B by two strong screw bolts *s s*, and in the centre of it is fixed, by two short bolts, a brass nut, containing a female screw, or worm, for receiving the upper end of the great vertical spindle or screw S, by which the pressure is produced. The third bar D, called the *shelf*, or *till*, is intended to guide and keep steady a part called the *hose*, which contains the spindle and the screw. The next cross bar E, called the *winter*, is placed between the cheeks, in order to support the carriage; and it sustains the effort of the press below, in the same manner as the head does above. The *spindle, or screw*, FF is a strong vertical bar of iron, terminated at the lower end with steel. Its upper end is formed into a small screw, which works in the small screw in the brass nut of the head; and in the *eye* of the spindle, a little below its upper end, is fixed the crooked bar or handle H, by which the press is wrought.

Beneath the lower end of the spindle is placed the *plattin* GG, or the body which gives the pressure to the paper. It is suspended from the point of the spindle by the *hose*, a square frame or block of wood, shown at K, which is guided by passing through the shelves. The lower end of the spindle passes through the hose, and rests by its point in the plug, fixed in a brass pan supplied with oil, which is again fixed to an iron plate let into the top of the plattin. When the pressman, therefore, pulls the handle H, he turns the spindle, the round end of which moves in its screw box, and, by descending, brings down the plattin, which thus presses upon the paper lying above the types. The plattin is suspended from the spindle, and rises up again with it, by means of a *garter*, or fillet of iron screwed to the *hose*, and entering into a groove round the upper end of the spindle, to prevent the hose falling down upon the spindle. The plattin is hung truly level by four threads passing from its four corners to the four corners of the lower part of the hose.

The next important part of the printing press is the *carriage* LL, the object of which is to bear the types, and carry them below the plattin. The carriage is supported on a horizontal wooden frame, the fore part of which is sustained by the *forestay m*, while the back part rests on the winter. Beneath the plank of the carriage, *cramp irons*, or short pieces of iron and steel, are nailed, which slide upon two long iron bars, or ribs, fixed upon the upper part of the horizontal wooden frame. In order to run the carriage in and out upon the wooden frame, there is placed beneath the carriage the *spit*, or a small spindle, having a double wheel on the middle of it, round which leather belts are fastened, the opposite ends of the belt being nailed to each end of the plank of the carriage. On one of the ends of the spit is fixed the winch, or handle *n*, by turning which the pressman can run the carriage in and out below the plattin at his pleasure. The carriage consists of a strong wooden plank, on which is fixed a square wooden frame, forming the cell, in which a polished stone is placed, to sustain the form or frame of types. Stay-belts of leather are fixed to this cell by one end, and by the other to the cheeks of the press, so as to prevent the carriage from running out too far, when drawn from under the plattin. On the outer end of the plank is fixed the *gallows* MM, which sustains the *tympans*, when they are turned up to receive a new sheet of paper. These tympans, shown at N, N, are light square frames covered with parchment. They consist of three slips of thin wood; with a *head-band*, or top-slip, of thin iron. The two tympans are so constructed that the one is small enough to lie within the other, and the exterior one is fitted by iron hinges to the cell. Two or three folds of blankets are placed between the two tympans, to equalize the pressure of the plattin upon the surface of the types. A square frame of very thin iron P, called the *frisket*, is fastened by hinges to the head-band of the exterior tympan. It is made to fall down upon the tympan, to inclose the sheet of paper between them; and the frisket is covered with a sheet of paper, or parchment, which is cut out so that the sheet, when placed between the tympan and frisket, and folded down together on the form of types, may receive the ink from the surface of the types, while the frisket-sheet preserves the margin from being soiled. When the tympan and frisket are thus folded down, they lie flat on the form of types. The carriage containing them is then run beneath the plattin, so that when the handle H is pulled, the plattin presses upon one-half of the form of types; the carriage is then run farther in beneath the plattin, so that a second pull of the handle causes the plattin to press upon the other half of the form of types. In this way the impression of the types is made upon the paper by two separate pulls. By turning the winch H, the carriage is withdrawn from beneath the plattin, and the tympan on being lifted up round its hinges, rests obliquely against the gallows. The frisket is then lifted up on its hinges, and supported by a slip of wood descending from the ceiling, till the printed sheet is taken out and a clean one put in.

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sses.

As the operations of printing are now so common in every civilized country, it would be a waste of time to describe them here. We shall, therefore, proceed to describe the various improvements which have been successively made upon the printing press.

The Apollo Press.

Apollo

In consequence of the impression being taken by two successive pulls with the ordinary press, a part of the middle of each sheet received two separate pressures; and the effect of this was, to diminish the uniformity of the impression on the paper. Besides this defect, a great deal of time was lost in two separate pulls, so that it became highly desirable to have a press, the plattin of which was sufficiently large to print a whole sheet at one pull. The first press of this kind with which we are acquainted was the Apollo press, which was brought from France many years ago. In this press the plattin was made of iron instead of wood, and was large enough to print the whole sheet. The lower surface of the plattin, which was formed of brass, was ground truly flat, and it was made sufficiently strong not to bend, or yield at the points most distant from the centre of pressure. The spindle was joined by connecting rods, with a long lever placed at the side of the press, which was wrought by the pressman with both hands in a vertical plane, like the handle of a pump. These presses were used in printing newspapers, but, from the great fatigue of working them, they soon fell into disuse.

Prossen's Printing Press.

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This printing press, for which a patent was taken, is described in the eighth volume of the *Repertory of Arts*, p. 368. The improvement on which the patent principally rested, consisted in placing a spring between the cap and head, to resist the upward pressure, and another below the winter, to resist the downward pressure.

Roworth's Printing Press.

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The first real improvement upon the printing press was made by Mr. Roworth, a printer in London. The spindle, in place of being furnished with a screw, is entirely plain, and has its upper extremity turned into a smooth cylinder, which works through a socket fitted into the head of the press. On the upper end of the spindle, immediately beneath the head, a short cross arm of hardened steel is fixed, the polished surface of which acts against a circular inclined plane of hardened steel, which being actually a part of a screw, causes the spindle to descend. The inclined plane, however, has different inclinations at different parts. At first the inclination is great; so that, at the beginning of the pull, the descent of the plattin is rapid, but when the plattin has approached near to the tympan, and, consequently, when the force is really required, the inclination of the plane is very slight, so as to produce a great mechanical effect.

The Stanhope Press.

e Stan-
pe press.

One of the greatest improvements upon the printing press was made by the late Earl of Stanhope, a nobleman distinguished by his ingenuity and his mechanical knowledge. This press, which is described minutely in Stower's *Printer's Grammar*, is represented in perspective in Fig. 2, and in section in Fig. 3, where AA is the body of the press, or a massive cast iron frame, formed in one piece, which rests upon a wooden cross BBC, to which it is firmly screwed down. Two horizontal rails DD, are screwed at *b b* to two projecting pieces, cast all in one with the body of the press, in order to sustain the carriage when the pull is made. The ribs of the carriage slide in grooves formed along the upper surfaces of these rails, and it is moved by the handle *m*, with a spit and leather belts, very similar to those of the common press.

Printing
Presses.

PLATE
CCCCLXVIII.
Figs. 2, 3.

In the upper part *d* of the body of the press a brass nut, or female screw, is fixed, in which the upper end of the spindle works. The chief improvement in Lord Stanhope's press, consists in his method of giving the descending motion to the screw. The handle H by which the press is worked, is firmly fixed into the lower end of the vertical bar M, the lower part of which moves in a hole in the main frame, while the upper end of it passes through a collar in the projecting piece *c*. After passing through this collar, the end of the bar M joins a short lever N, which is again connected by the link O with another short lever P, fixed upon the upper end of the screw.

When the pressman pulls the handle H, he turns round the spindle M, and by its connexion with the rod O, &c. the great lever turns with it, and causes the plattin to descend and produce the requisite pressure. The power of the lever H is, however, transmitted to the screw, so as to be proportioned to the effect which is wanted at the different parts of the pull. At the beginning of the pull, for example, when motion only is wanted, the handle H lies in a direction parallel to the frame across the press, and the short lever N, which is nearly perpendicular to it, is also nearly perpendicular to the connecting rod O; but the lever P of the screw makes a considerable angle with O, and then it acts by a spindle radius to turn the screw. At the commencement, therefore, of the pull at H, the lever N acts with its full length upon a shorter length of lever on P, so that the screw will be turned more rapidly than if the link O were attached to it. On continuing the pull, however, the situation of the levers changes, the length of P continually increasing in its acting length from its coming nearer to a perpendicular to O, and the acting length of N diminishing, because, by the obliquity of the lever, the link O approaches the centre. The handle H likewise comes into a more favourable situation for the pull, as the pressman finally pulls in a direction nearly at right angles to its length. In this way the plattin is at first brought quickly down upon the paper, where motion only is wanted; but as the levers are gradually coming into the most favourable position for exerting the greatest force, this maximum pressure is produced just at the moment when it is wanted, namely, when the plattin touches the paper to be printed. The range of the handle is limited by a stop, which is moveable to a small extent, in order to vary the pressure for different kinds of work. The form of types, in place of resting upon a stone, lie on a cast iron block, which has its upper surface ground exactly flat, and placed perfectly horizontal.

In the Stanhope press the plattin is so large as to print a whole sheet at one pull.

In some of these presses, a variation of power is obtained by a screw adjustment at the end of the link O, by which it can be shortened. This is effected by fitting the centre pin, which unites it to the lever P in a bearing-piece, which slides in a groove formed on the side, and is regulated by the screw. By this means the descent of the plattin may be increased or diminished. The surface of the plattin is turned so as to be perfectly plane.

Heine's improvement on the Stanhope press.

Since the invention of this press various improvements have been made upon it, one of which by M. de Heine has been secured by a patent. In place of the screw he has substituted a spiral or curved inclined plane, which is fixed to the head of the press. On the upper end of the spindle is fixed a cross arm, which, acting against the fixed inclined plane, performs the functions of the screw. The advantage of this substitution is, that the acting faces admit of being made of hardened steel.

Keir's improved Stanhope presses.

The Stanhope press has likewise received several valuable improvements from Mr. Peter Keir. He forms the slider *d*, by boring out a cylindrical hole down the centre of the press, and he fits accurately into this a cylinder, to the lower end of which is fastened the plattin. A flat side is made to the cylinder, which is prevented from turning round by a bar of iron screwed across the two cheeks, and bearing against the flat side of the cylinder. Mr. Keir has also improved the lever apparatus. By a screw cut into the lower end of the spindle M, and fitted into a nut, the spindle is made to rise and fall through a space equal to the descent of the great screw in the same time. The connecting rod O is thus made to pull in a horizontal plane, while in the old construction one end remains level when the other descends, the consequence of which is an unequal wearing of the joints.

Midhurst's improved press.

An improvement on the printing press has also been made by Mr. Midhurst. It resembles generally the common printing press; but the plattin is the size of a sheet, and in place of a screw is used a plain spindle; on the lower part of which, just above the bar, is fixed a circular plate, which affords steps for the points of two iron rods, which extend up to the head, and are supported in that place by their points entering sockets. These rods have an inclined position when the plattin is raised, although both the ends of them are at the same distance from the centre of the spindle; but when the spindle is turned by the bar, the circular plate in which the lower points of the iron rods rest, moves round in a circle, and the upper ends remain stationary. Hence they come towards a vertical position, and by this motion the spindle and plattin are made to descend. The advantage of this contrivance is, that there is little friction, and that this power is immensely great when the rods come nearly parallel to the spindle.

Ruthven's Printing Press.

Ruthven's printing press.

This very ingenious piece of mechanism, invented in 1813 by Mr. Ruthven, printer in Edinburgh, possesses advantages which render it in many respects superior to any other. In all the presses which we have described, the motion of the carriage containing all the types and frame below the plattin must be considered as a piece of mechanism which should if possible be avoided. To remove this necessity seems to have been the primary object of Mr. Ruthven. He seems to have resolved to keep the form of types fixed, and to make the plattin moveable; and of course the whole mechanism of his press acquires its character from this fundamental improvement.

Plat CCCCLX Figs. 4

The construction of this press will be best understood from Plate CCCCLXVIII. Figs. 4 and 5, where AA is the bed which sustains the form of types which remains fixed in the same position. This bed is supported by a framing of cast iron, as shown in the figure. The plattin is shown at PP, and is joined to a strong cast iron bar MM by screws *s*, *s*. At the ends of this bar there are strong iron bolts *b*, *b*, secured by screw nuts at the top. These bolts terminate below in beads or projecting pieces, which fit exactly the hooks or clutches at E, E. At each of the remotest ends of the bar MM is fixed an oval steel spring, and on the lower ends of each spring are two grooved wheels or rollers, which run on a rail-way, so that the whole plattin may be pushed off the form of types after it has given the pressure, and again brought above it to press the succeeding sheet. These springs have their elasticity and form so adjusted, that the lower surface of the plattin is raised above the margin of the tympan, where the springs are not in action. The plattin, therefore, readily moves into its position immediately above the tympan, and as soon as it is pressed down upon the types, the action of the springs raises it above the margin of the tympan, and permits it to be pushed aside by the handle *h* from the form of types.

We have already mentioned, that the lower ends of the bolts *b*, *b*, which are generally shaped like the frustum of a wedge, go into a hollow of the same form when the plattin is pulled above the types. The object of this is to lock the plattin to the compound lever * EFGHKL, which, when moved by the handle H, presses the plattin upon the types. This part of the apparatus consists of two levers DF, DF, moving upon fixed centres at D, D. The clutches, or wedge-shaped cavities, are jointed to these levers near the fulcra D, D, so that when the extremities F, F of the levers DF, DF are pulled down, the clutches are also pulled down, and therefore pull down the plattin to which they are locked. The descent of the ends F, F is produced by a link G united to both, and this link is again joined to another lever, whose fulcrum is at K, while the other end is connected with the handle H, by which the pressure is given. These levers are so arranged, that the maximum force is given when the plattin just begins to touch the tympan. The plattin in Mr. Ruthven's large presses is the size of a full sheet; and in consequence of the pressure not being propagated from its centre, the pressure over the whole sheet becomes more equable than in other presses. This press has also the advantage of being much cheaper than the Stanhope press, and other presses upon a similar construction.

Clymer's Columbian Press.

Clymer's Columbian printing press. Fig. 6.

This press, which also depends on a combination of levers, was invented in Philadelphia in 1814, by Mr. George Clymer of that city. It was introduced into London in 1818, and a manufactory established for making them. The construction of this press will be readily understood, from an inspection of the elevation in Fig. 6, where AA is the main frame resembling the letter U. The plattin BB, fixed by screws to the bottom of a square pillar P, two opposite angles of which slide in angular grooves in the two pieces of metal *a, a,* which stretch from the frame, and have adjusting screws, &c. to tighten them to the square pillar.

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* An account of the principle of these combinations of levers will be found in the new and enlarged edition of Ferguson's *Lectures*, vol. ii. p. 264.

The mechanism or combination of levers, by which the descent of the plattin is produced, is shown at HIKLMN. The main lever LMN moving round a strong bolt at N, passes through a fork in the frame at N. The other end L of the lever passes through an aperture between the vertical bars at *m,* and its central part at M has a stout pivot or gudgeon cast upon it, which goes into collars at the top of the square pillar P, kept together by strong bolts. Two links L, *l,* one being on each side, connect the main lever with the second lever *n, o,* moving on a fixed centre at *o* in the great frame. Another link *p* is connected by an universal joint to *n* at one end, and at the other to the lever or handle H, at which the pressman works. This handle turns on a fixed centre pin extended from the great frame.

On the top of the vertical bars at *n* is placed the fulcrum *f,* of the counter-lever *g, f, h,* which carries an adjustible counter-weight W, the end *g* being united by a link to the end L of the main lever. The use of this counter-weight is to raise the main lever into its acting position, after the handle H has been let go by the pressman.

Barclay's American Press.

This press has been lately introduced into this country from America, by Mr. David Barclay, its inventor. The great parts of the machine it is unnecessary to represent, as it is only the method of giving the pressure to the plattin that gives it its chief interest. We have, therefore, represented this in Fig. 7, where A, A represent the two upper inclined plates, and B, B the under one, which is fixed on the top of the plattin, while the upper one A is fixed to the head of the press. A wedge W, made of well-hardened steel, is fixed to the end of the lever handle of the press, so that when this handle is pulled, the wedge W is forced between two steel rollers C, D, so as to roll them along between the two inclined steel plates, and consequently leave the lower plate B and the plattin to descend. The left hand figure represents the rollers when the plattin is pressed down; and the right hand one the same rollers when the plattin has risen to its place of rest. The lever handle H moves round *n* as a fulcrum, and by increasing or diminishing a connecting link the required force is obtained.

As the rollers are necessarily above the centre of the plattin, the plattin is guided in its ascent and descent by two metallic bars, not very distant from its margin, and at the top of each of these bars there is a spiral spring, which bears against the top of the frame, and by balancing the weight of the plattin, keeps it always clear above the tympan when the handle is at rest.

Wells's Printing Press.

This press, which has been recently constructed in America by Mr. Wells of Hartford, has been described by the late Professor Fisher. The plates, drawing, and description of it are taken from Ferguson's *Lectures,* vol. ii. p. 265. "The frame is of iron, cast (with the exception of the feet) in a single piece; and is of such form and dimensions as to be incapable of springing while the press is in operation. The plattin (4) is of cast iron, and is of the dimensions of an entire form. The circular projection in the middle, with six radiating pieces, gives it an ample degree of firmness. The plattin is immediately acted on by bringing nearly into a straight line the two main levers (6) and (17.) These levers, in presses of the medium size, are fifteen inches each in length, and in the position represented in the figure, which is that of the greatest obliquity, they want two and a quarter inches at their point of contact of being straight. The lower end of each lever is four inches broad, and is rounded off into a portion of a cylindrical surface of half an inch radius. A piece of steel fixed within the circular projection in the middle of the plattin has a hollow bush or bed of corresponding figure; in this the lower end of the lever (17) is set. The upper end of this lever is hollowed out in the same manner to receive the lower end of (6), and the upper end of (6) to receive a projection from the under side of the top of the frame. At (5) there is a provision for raising or lowering this projection by slips of sheet iron or tin, and thus adjusting the position of the levers to the best working state. The ends of the levers and the beds in which they rest are overlaid with steel, and the beds are so contrived as permanently to retain a small quantity of oil. (9) is a spindle of wrought iron, fastened at the upper end by a screw and nut to the shorter arm of the balance lever (7), and branching below into three parts, each of which is attached by an adjusting screw to the plattin. This answers the double purpose of keeping the plattin steady, and enabling the weight (18) attached to the longer arm of the lever (7) to lift the plattin and carry back the bar immediately after each pull. The plattin is still farther guided by lateral projections which run in grooves connected with the cheeks of the press.

PLATE CCCCLXVIII. Fig. 8.

The mode in which the movement of the working bar (12) is transmitted to the main levers, will be best understood from Fig. 15, which is a representation of the parts 11, 12, 13, and 15, as they would appear to an eye looking down upon the press from above. The bar BA (the lever worked with the hand) is inserted into a strong cast iron roller (13) which turns in sockets secured to the right cheek of the press. From this roller, about 6 inches above the bar, proceeds an arm AC, three inches in length, and to the extremity of this is connected by a joint the driving lever CD, 21½ inches long. The extremity D is connected in a similar way with the iron rod EF; one end slides in a pewter guide, (represented by 10 in Fig. 14,) while the other end is fastened by a hook and eye to the upper main lever (6) at the distance of an inch from the bottom. (16) is a bar check, which limits the revolution of the bar to a precise arc. The *carriage* part of the press, which stands in front of the upright iron frame, presents nothing materially different from the Columbian press, and will not require a particular description.

The operation of the mechanism will now, it is believed, be sufficiently apparent. When the bar BA is brought round, the roller A and the arm AC are made to turn with it; this drives forward the lever CD, and this in its turn gives motion to EF, which, by means of the elbow at F, brings the two main levers (6) and (17) towards the position of a straight line. As the movement of the bar is continued, the mechanical advantage not only increases from the gradual approach of the two main levers to a vertical position, but from the approach of ACACD towards a straight line. The combination is therefore one which is eminently adapt-

Printing Presses.

to effect that rapid increase of power, near the end of the pull, which has been already mentioned as the great desideratum in the construction of this part of the printing press.

To determine the actual gain of power at the beginning and at the end of the pull, measurements have been taken from an individual press of the lines necessary for the computation. When the bar was thrown back, the angle ACD (of the triangle ADC, formed by joining the three centres of motion with straight lines) was found to be = 113° 52′, CDA = 7° 12′, and the distance of the centre of motion of the two adjacent ends of the main levers from the straight line joining their outer extremities = 2¼ inches. The length of AC was 3⅛, and the distance from A to the part of the handle where the hand was generally applied was 24 inches. Hence, as will appear from the theorems given above, the gain of power will be found by compounding the following ratios: 24 to 3⅛; cos. 70° 12′ to sin. 113° 52′; 15 to 2 × 2¼; and 14 to 15; which gives a total of 20 to 1.

At the end of the pull the angle ACD = 172°, the angle CDA = 1° 3′, and the distance of the vertical levers from a straight line, according to the specification of the inventor, which was found nearly exact, = half an inch. Hence the gain of power will be found by compounding the following ratios: 24 to 3⅛; cos. 1° 3′ to sin. 172°; 15 to 2 × ½; and 14 to 15; which gives a result of 763 to 1. It thus appears that the power gained is about thirty-eight times greater at the end than at the beginning of the pull."

Hope's Printing Press.

Hope's printing press.

One of the latest printing presses is that invented and constructed by Mr. Hope of Jedburgh, who has secured it by a patent. This press, which is represented in Fig. 9, is an improvement on the Stanhope press; and the patent is taken out merely for a new combination of levers. A plan of that part of the press is shown in Fig. 10, where *a*, *a* are the iron standards of the press, and *b* the plattin, with the form of types under it. The handle *d* of the press is attached to the short arm, or lever *e*, turning on a pivot in the iron pillar *a*. The connecting rod *f* is fixed to *e* by a joint, and in the usual construction of the Stanhope press, it is connected to another short arm fixed to the metallic screw or bolt in the joint of the press. In the present new construction, however, the rod *f* is connected by a joint to one arm of the forked lever *g*, which moves upon a cylindrical fulcrum on the pillar *a*, while the other end is joined by a pivot to the posterior rod *h*, jointed to a short arm *i*, extending from the bolt of the press. Mr. Hope therefore gains additional power, by using the additional connecting rod *h* and the bent lever *g*.

Fig. 9.

Fig. 10.

When the press is at rest, the combination of levers has the position shown in the figure; but when it is in action, the path described by the different parts is shown by the dotted line.

In place of the male and female screws by which the plattin generally rises and falls, he substitutes two inclined planes; but these do not form a part of his patent.

This press has been used in several printing offices both in England and Scotland, and it is admitted to unite the advantages of cheapness with great power and accuracy.

Print Press

Several other presses have been contrived. In Brown's press, for which a patent was taken in 1807, the screw is moved by a bevelled wheel and pinion, and the types are inked by two elastic rollers. Brookes's press consists in the application of the compound levers of the Stanhope press to the common press.

Copp plate p ing pr

PRINTING PRESS, Copperplate. The invention of the copperplate printing press seems to have been made about the same period as the type printing press. In the absence of authentic record, tradition has ascribed the discovery to a silver-smith, who in order to save labour, and insure the accurate and rapid multiplication of engraved patterns upon his works, was in the habit of inking in the pattern, and taking off impressions with a burnisher from the figure first executed. This is so simple, and generally so well understood a process, that we need not waste time in describing it.

The success attending this discovery, immediately suggested that the same results would be obtained in a more perfect manner, by a proper application of the pressure of a roller to the whole surface of the plate at once, instead of the labour of passing the burnisher in the hand gradually over each individual spot of engraving. The first invented presses appear to have been constructed with considerable accuracy and power from the excellence of the impressions of the ancient works which have reached us, but which it would be out of place to enumerate here.

In the present age of improvement and novelty, many alterations, and certainly great amendments have been made, both upon the construction of the press for the higher branches of printing, and also upon that adapted to more ordinary purposes. Among the most prominent of these improvements is the application of the wheel and pinion, instead of the lever or cross for driving the press, and the substitution of cast iron in place of wooden rollers. Other plans have been suggested for the purpose of increasing the rapidity of multiplying the impressions of commonplace works, the most ingenious of which is the invention of the celebrated Mr. Perkins, and of which a complete account will be found in the *London Journal of the Arts*, No. III. Plate VIII. Figs. 3 and 4. We shall describe these presses after we have detailed the construction of the more simple machinery; but before proceeding, it may not be out of place to remark, that the principal requisites of a good copperplate press are perfect truth in the manufacture of the rollers and plank interposed between them, and the judicious application of such a working power as shall cause the least bodily fatigue to the printer. If the workman has to apply too much of his strength to drive the machinery, his hand will be made to shake in consequence of the exertion, and thus he will be rendered incapable of cleaning off the ink from the plate, with that delicacy of touch which is indispensably requisite in finer works. The printers of calico goods, aware of the importance of this consideration, have skilfully applied the power of the steam engine for this purpose; and we have been informed that the presses in the bank of Ireland for printing their notes, are also driven by the same means.

Plate CCCCL Fig. 11.

Fig. 11, Plate CCCCLXVIII. represents the most simple copperplate press, which, with the exception of the spindles of the two rollers, may be entirely constructed of wood. A is the upper roller, B the under roller, a little larger in the diameter than the upper; C the plank upon which the copperplate P rests. The plate should be placed upon a piece of pasteboard of a little longer size than the paper upon which the impression is to be taken, in order to defend the plank against the indentation consequent on the necessary pressure of the roller. D is the strongest part of the frame of the press, commonly called the cheeks; *d* an open space in the cheeks for admitting the axes or spindles of the rollers. The upper roller has a brass bush fitted to the upper half of the spindle, and upon which is placed a proper quantity of pieces of pasteboard and felting in alternate layers, in order to give elasticity to the pressure, and greater ease to the workman. The spindle of the under roller is also placed in a brass bush, sometimes with, but oftener without, a mass of elastic substance. In this opening two screws are fixed, so as to act upon the elastic mass placed above the spindles of the upper roller, for the purpose of regulating the pressure necessary to produce the requisite boldness of the impression. Some skill is required in the management of these screws, for we have seen that strength of body, without this knowledge, has actually broken the spindles of the rollers in vain attempts to perform what a judicious workman would accomplish with comparative ease. In order to keep the elastic mass above described as efficient as possible, it should be taken out at night, turned, and replaced in the morning. Much of the excellence of the work also depends upon the proper quantity of felting or cloth being warped round the upper roller *b b*. If too many layers are put on it, the result will be, that greater power will be required to drive the press, and the impression will not be so clear and distinct as it ought; and again, if too few layers of cloth are applied, the paper will be stained by the hardness of the roller, and it will have a glazed appearance, and be liable to be cut by the edges of the copperplate. These defects also result (though in a less degree) from the want of a proper quantity of the elastic mass being placed above the spindle of the upper roller. E is the remaining part of the frame of the press, and F the levers or cross fixed to the end of the spindle, by which the motion is given to the upper, and communicated to the under roller.

Fig. 12. represents one of the modes of applying the power of the wheel and pinion for driving the rollers: A a pinion fixed to the cheek of the press, which acts in the teeth of the wheel B, which wheel is fixed to the spindle of the upper roller C. A cross, with eight spokes DD, is fixed to the spindle of the pinion A, by which the motion is communicated. This application of the wheel and pinion is certainly a considerable improvement, but it has its disadvantages. The chief of these are, that the pinion cannot be placed at a sufficient distance from the spindle of the upper roller, so as to admit of a wheel of sufficient diameter for it to act in to give the requisite power. Another disadvantage is the great length and number of the levers, which renders the action too slow for common work. We give the following description and representation, (Fig. 13.) of a neat, useful, and at the same time a very powerful press, which remedies these defects, and which has been in use for upwards of twelve years without requiring any repair. It is made wholly of cast iron, under the direction of Mr. Lizars of Edinburgh. Its chief qualities are its durability—the compactness of its form—the mode of applying the power of the pinion to the wheel seen in the engraving, instead of its being placed at the cheek of the press, as shown in *Fig.* 12.—and its cheapness, considering the great size of plate which its dimensions are calculated to take in. From an examination of the representation given in the accompanying plate, it will appear evident that by the mode of fixing the pinion, and from the great diameter of the wheel into which it acts, greater power is obtained; and from the pinion being worked by a winch-handle, greater uniformity and dispatch is given when required in common work. There is also a convenient apparatus for fixing the cloths in cases where the plate is too large to admit of the length of the cloth being warped round the roller and fixed to it. This apparatus is seen at A, Fig. 13. where the dotted line represents the cloths warped in a triangular form round the roller of the press, and extending to the two small rollers *b b*, which the cloths make to revolve along with the roller of the press. The diagram, Fig. 14. will convey a more perfect idea of this apparatus, AA, the two small rollers, round which and the upper roller of the press the cloths *b b* revolve, when the press is set in motion, *d d* represent two small screws, which are so contrived as to slacken or tighten the cloths when required. In Fig. 13. B represents the plank upon which the copperplate rests; it is also made of cast iron, and supported upon the small narrow rollers *c*.

Fig. 14.

This press is calculated to print a plate the size of a sheet of double elephant paper, and costs about £40.

The following description of Mr. Perkins's new presses, and the representations Figs. 15 and 16. are extracted from Newton's *Journal of Arts*.

Fig. 15.

"Fig. 15. shows an improved steel or copperplate, or block printing press. The principal improvements consist in a new method of heating the plate or block; in the use of a tympan for the purpose of saving the expence of making the plates or blocks any larger than is necessary to receive the engraving, as well as to save ink, and also time and labour in changing the plates or blocks. The manner in which these objects are effected, will appear from Figs. 15 and 16. AA, &c. is the cast-iron frame of the press; B the upper cast-iron roller, on the axis of which is fixed the wheel C, with handles around it for the workman to pull by; D the lower cast-iron roller, EF the bed of the press, made partly of cast-iron and partly of wood; the part E is of cast iron, the better to resist the pressure of the rollers, and to convey the heat employed to the warm plate or block; the plate or block G is fixed upon the bed, by means of screws passing through counter-sunk holes made in the bed from the under side of it, and into screw holes made partly through the plate or block itself. The tympan H is a wooden frame, covered with copper, and turned into hinges I I, and having an aperture in it large enough to enclose the plate or block, the sides of which aperture are made feather-edges, so as to overlap the bevelled edges of the plate or block, and prevent them from soiling the paper. The cast-iron part of the bed of the press, with the plate or block upon it, is heated by means of a block of cast iron J, which is supported upon the plate K, with turned up edges, and which block is removed and replaced by another from time to time as it cools. In use, the frame of the press is inclined, the front end resting upon the floor, and the other being raised by two screws passing through screwed holes in the sill of the press frame, one of which screws is shown at L. The intention of this inclination is to cause the bed to return after the impression is made of its own upon the end of *s*, and by forcing it either way, will adjust the wheel with respect to the plattin, till they exactly correspond.

Elastic rollers.

The manner of forming the inking and distributing rollers with an elastic substance, is worthy of notice. After many trials, a composition of glue, mixed with treacle, was found to answer. The roller is made of a copper tube, covered with canvass, and placed in a mould, which is a cylindrical metal tube, accurately bored, and oiled inside; the melted composition is then poured into the space of the mould, and when cold, the whole is drawn out of it, with the glue adhering to the copper tube, and forming an accurate cylinder. The composition will not harden by exposure to air, nor does it dissolve by the oil contained in the ink.*

Steam Printing Machine.

Steam printing machinery.

M. Koenig, from Saxony, seems to have been the first person who conceived the idea of constructing a steam printing machine. Having failed in interesting the continental printers in his views, he came to London about 1804; and after many years of experiment and disappointment, he at last succeeded in erecting two machines for printing the *Times* newspaper, which was first printed by them on the 20th Nov. 1814. He afterwards erected another for Mr. R. Taylor, in Shoe Lane; one for Messrs. Bensley, which printed both sides of the sheet in succession, and another for the same house, which printed both sides of the sheet at once.

As this machine, however, was very complicated, many mechanics attempted to simplify it. This great object was soon accomplished by Mr. Dryden, who, under the direction of Messrs. Applegath and Cowper, constructed two machines for Messrs. Bensley, one double and the other single. The double machine throws off from 800 to 1000 sheets, printed on both sides, in an hour; and the single one from 1500 to 1600 printed on one side.

Plate CCCCLXIX. Fig. 1.

One of these double machines is represented in Plate CCCCLXIX. Fig. 1. The machine receives its motion from an axle, on which there is a pinion which works into the teeth of the wheel C. The sheets of paper lying on the table A are laid by a boy, one by one, on the table B, which has a number of narrow linen tapes extended over its surface. The action of a lever fixed on the cog wheel of the main cylinder F, gives motion to a lever on the axis of the roller D, which causes the roller C and D to move round part of a revolution, by which motion the sheet of paper is advanced between the rollers *h* and E, where the two systems of endless tapes meet. When the sheet is thus taken off the table B, the rollers C and D are carried back by a weight W, attached to the cord *a*, so as to be ready to deliver the next sheet into the tapes. The first sheet of paper is now carried along between the systems of tapes to the circumference of the main cylinder F, mounted on a strong axis, and covered with a blanket, and by the revolution of this cylinder, the paper is pressed against the form of types lying below F. While one of the sides of the sheet is thus receiving its impression, the other form of types below G is receiving its ink from the inking cylinders. By the motion of the machine the sheet, one of whose sides was printed by the cylinder F, advances between the tapes and round the cylinders H and I, by which it is inverted and applied in this inverted position to the blanket on the surface of the second cylinder G, by which the other side of the sheet is printed by the form of types below G. The sheet is now at the point *i*, where the two systems of tapes separate, and it is delivered on the board Z, from which it is removed by a boy.

As the operation of this machine depends upon the system of tapes, it will be necessary to explain their construction at greater length. The tapes are so combined, that they always fall either between the pages in the form of types, or near the margin of the sheet of paper. When the paper is therefore taken in between the tapes, it must move along with them till it is brought exactly above the form of types to receive the impression.

If we suppose one system of tapes to begin above the cylinder E, they then follow the under circumference of the roller F; and passing over the upper part of the roller H, and then below the roller I, they surround a considerable portion of the main cylinder G; and after passing along so as to touch the cylinders *a*, *b*, *c*, *d*, and *e*, they arrive again at the roller E, from which they started, thus forming an endless system. The second system of tapes beginning at *h*, pass on to E, where they come into coincidence with the first system, each tape in the one system corresponding to each tape in the other. In this state of coincidence, they advance under F, above H, under I, and round G, separating at the roller *i*, where they descend to *k*, and passing in contact with the rollers *m*, *n*, *o*, they return to the roller *h*. These two systems of tapes revolve without interfering with each other, and all sliding or displacement of the tapes is prevented by the uniform motion produced by the toothed wheels which connect the cylinders F, G, H, I, and E. The reciprocating motion of the carriage which holds the forms of types, is produced by a pinion on the upright axis K, which works in the rack LL, connected with the carriage by a system of levers.

The types of each form are inked by two separate inking apparatuses, shown at N and O. A roller at N, driven by a band from the axis of G removes slowly a film of ink from a mass of ink on a horizontal plate, nearly in contact with its circumference. An elastic roller O, which moves round an axis *p*, is connected with the axis of G by an excentric circle, which causes it to rise into contact with N; and after taking a little ink from it, to descend upon the metallic table T, fixed to the type carriage, so as to receive ink from O during the reciprocating motion of the carriage. The supply of ink on the table T is finely regulated by the elastic rollers R, and it is afterwards taken up by the rollers S, which lay it uniformly upon the types while they pass under these rollers.

Mr. A gath's prove in pri machi

Various improvements on printing machines have been lately made by Mr. Augustus Applegath, who has secured the exclusive right to them by patent in 1823. His improvements relate to five points.

1. He passes the distributing ink rollers diagonally instead of directly across the ink table.

2. He makes the ink table, which was formerly metallic, of flexible materials, such as linen, woollen, canvass, carpeting, leather, &c. covered with a smooth coating of varnish paint, or the elastic composition of glue and treacle.

3. He inks the form of types by a system of rollers attached to endless chains or bands.

4. He makes the plattin or pressing surface in the

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* The sugar contained in this composition attracts moisture from the air, and this prevents the glue from getting hard.

form of a cylinder, with flattened sides, or of a prism with any number of sides.

5. He uses a revolving tympan frame, which carries a number of tympans, for the purpose of receiving the sheet of paper, and bringing them successively into the situation where they are to be printed. See Newton's *Journal*, vol. vii. p. 7.

Another patent for a printing machine was taken out in 1822, by Mr. John Bold of Bermondsey; but as it is too complex to be described without the aid of many figures, we must refer the reader to Newton's *Journal of the Arts*, vol. vi. p. 11, July 1823, where a drawing and description of it is given.

Church's Type-Founding and Printing Machinery.

The very remarkable apparatus for printing, invented by Mr. William Church of Birmingham, and secured by patent in 1822, consists of three machines.

1. The object of the *first* is to cast metallic types with extraordinary expedition, and to arrange them for the compositor.

2. The *second* machine selects and combines the types into words and sentences. And,

3. The *third* is for taking impressions from the types so arranged.

1. *Type Founding Apparatus.*—The machine for casting the types is shown in Figs. 2, 3, and 4 of Plate CCCCLXIX. the first being a plan, the second an elevation, and the third a section of the machine. In these figures *a* is a box, holding the melted type metal, (which flows from the fountain *d*) having in front of it the mould *b*, (Fig. 3.) and *b b* Fig. 5. formed by a steel bar, with a number of vertical grooves to hold the metal. Below this *mould* are placed the matrices *c c*, which form the letter or face of the type. By means of a plunger *e*, a portion of the melted metal is displaced from *a*, and rushes with force into the grooves of the mould bar, and into the matrices. The machine operates in the following manner. A fly-wheel *g*, driven by hand, moves the shaft *h*, carrying the cam wheel *i i*. As soon as the cam, seen at 1 Fig. 3. is slid from beneath the end of the lever *j*, the plunger *e* is drawn down by a weight appended to *j*, and forces a portion of the metal into the moulds and matrices. As the cam wheel advances, a projecting part of its periphery 2 raises the end of the lever *k*, and a short arm at the reverse end of the shaft, which carries this lever *k*, shifts the mould bar *b* laterally, and brings its grooves under a series of punches, extending from the bar *l l*, Fig. 2. The matrix bar *c*, is now unlocked by a cam 3 bearing against the end of the lever *m*, the reverse end of which slides back a bar holding a series of wedges *n n*, and thereby permitting the matrix bar to descend the one-eighth of an inch, so as to withdraw the ends of the cast types from these matrices. Another cam 4 striking the upper end of the lever *o o*, causes the reverse end of it to draw forward the matrix bar *c* from beneath the types. The cam 5 now pushes back the arm *p* of a compound lever, and causes the other arm *q* to force down the bar *l l* with its punches, which push the types out of the mould bar into the guides *r*, which are square tubes formed to the figure of the types, and twisted one quarter round, in order to bring the body of each type into the proper position for the composing machine. After the types have descended in the guides, a pair of guide cams *t* (Fig. 3.) between which the end of the lever *v* acts, cause by their obliquity the lever *v* to vibrate and slide the projected bar *w* backwards and forwards, so that at every operation of the machine, the types are pushed backwards in ranges of the box *s*, each type preserving its erect position. When the cam 5 has passed the lever *p*, the weight attached to it causes the punch-bar and punches *l* to rise into their former position. The cam 6 now pushes back *o*, brings the matrix bar beneath the mould bar, and the matrix bar is locked up by the cam 7, which, acting on the end of the lever *m*, pushes the wedges into their original situation. The grooves for the moulds are replaced over the matrices by the friction roller at the end of the lever *k*, descending from the elevated part of the periphery of the wheel *ii* at 8, and shifting back the mould bar. One entire revolution having been performed, the cam 1 is again brought under the end of the lever *j*, which raises the plunger *e* to be ready for a second operation.

The mould bar has many turnings cut through it, (as shown in Fig. 6.) for the passage of cold water to cool the type metal. The water is conveyed by a pipe *x*, and discharged by an aperture at *y*.

Composing apparatus. Figs. 7, 8.

2. *Composing Apparatus.*—The types being arranged in files of letters, are placed in boxes or slips, shown at *a*, *a*, Fig. 7. *b b* are a number of jacks, each of which has a key attached to it as in the harpsichord. There are four rows of keys, as in Fig. 8, in order that any one of them may be touched by the finger; and *c c*, Fig. 7. is a number of slits corresponding to the keys, through which the heads of the jacks pass. Each file of letters stands exactly over the head of its jack. When the finger presses on the key *b* 1, Fig. 8. the head of its jack *b* 1 pushes forward the lower type of the file *a*, against which it stood, to the front part of the plate *c*. As the key *b* 1 descends, the lever *e* is raised by the descent of *d*, and the end of *e* enters a snail groove in a snail wheel *f*, connected by a train of wheel-work, to a barrel *g*, containing a spring intended to act as a clock-movement, to give motion to the arms *h h* in front. The lever *e* acting as a trigger, lets off the clock movement, whenever a key is depressed, and the wheel *f* revolves once on the descent of each key. Each of the revolutions of *f* raises and depresses the connecting rod *i* by the crank on its axle. This causes the shaft *j*, and the collecting arm *h*, to vibrate, so that each turn of *f* gives a pendulous motion to the arms *h*, *h*, and brings together the collectors *k*, *k*, which slide the type from any part of the plate *c* to the centre, and this type is pushed down through an aperture in the plate into the curved channel *n*, *n*, which answers the end of a composing stick. This is done by the front part of the lever *m*, which descends while the rod *l* is pushed up by the wheel *f*. The types may now be taken in the usual manner from the composing stick, and arranged into pages.

Printing apparatus. Figs. 9, 10.

3. *Printing Apparatus.*—A side view of this machine is seen in Fig. 9, and a section through its middle lengthwise in Fig. 10, where *a* is the table to hold the form of types, *b* the plattin, *c* the inking rollers, and *d*, and *d* 1, the friskets. The machine is moved by a handle and fly-wheel, on the axis of which are the pullies *e*, from which cords pass to *f*, and from *f* an endless chain extends to a pulley at the reverse end of the machine. This chain, attached to the frame of the inking rollers, draws them, by alternating revolutions of the pullies *e*, over the table and form of types *a*. These movements of the inking roller are produced by a peculiarly formed endless screw (on the axle of the pullies *e*) with a cross thread, into which a tooth works on the under side, and causes the screw to slide backwards and forwards laterally, locking alternately into one of the pullies *e*. The ink is taken up from the

chemical speculations; no one listened to him. By degrees, however, the system of Lavoisier was consolidated: finally adopted by its most stubborn opponents, it became generally known; and the greater part of our present chemists have studied the science under no other form but that which Lavoisier's hypothesis presents. The attention which, during five and twenty years, had been directed to this single point, was at length divided; and the luminous rays disseminated in the works of hostile or prior writers beamed forth anew. It may thus be affirmed, that the birth and consolidation of the antiphlogistic system put a stop, for a time, to the investigation of chemical proportions, which originated at the same period.

Lavoisier. Lavoisier himself advanced nothing very decided upon this point. He observed that there is one species of combination always limited to fixed proportions, and another which may take place in variable proportions; and he thought that being of a different nature, they ought to be carefully distinguished. He proposed to give them different names; he called the first *dissolution*, the second *solution*. A combination of the oxide of iron, with sulphuric acid, is an example of dissolution; but when the sulphate of iron is melted by water it forms a solution.

Some time after the death of Lavoisier, M. Berthollet, the most distinguished of his fellow-labourers, published a work under the title of *Essai de Statique Chimique*, in which he considered affinities, and the phenomena that depend on them, with a truly philosophic eye, and to the admiration of all chemists. He endeavoured to prove that the active forces are not so multifarious as the diversity of the phenomena might lead us to suppose; and he made it probable that chemical affinities depend entirely upon a single force; just as the force which causes a body to fall towards the earth is the same as that which retains the planets in their orbits. In a word, he conjectured that one day we should be enabled to calculate the former as accurately as, from a distant period, we have calculated the phenomena dependent on the other.

Berthollet. Berthollet, proceeding farther, attempts to prove that solutions depend on exactly the same affinity as dissolutions; the difference consisting merely in the degree of energy possessed by this affinity, which is smaller in the former case than in the latter. Elements, he maintained, have a minimum and a maximum, beyond which they cannot enter into combination; but between these two points they unite in every proportion; no other limit to their union being fixed. Whenever they happen to combine in fixed proportions between those two points, their union is due to other circumstances; for most part to cohesion, which renders the combination insoluble; or to expansion, which renders it gasiform. If in combining they undergo a high degree of condensation, the proportions in which they unite are always invariable; and for this reason gaseous substances never combine except in fixed proportions: hydrogen with oxygen, for example; azote with oxygen, and so on. But when, after combination, the elements continue in the same degree of density as before it, they may unite in all proportions between the maximum and the minimum. The regularity of proportion subsisting among the elements of acids, salts, &c. depends, according to this theory, on nothing but the condensation of the gaseous form, or on crystallization. Berthollet made a multitude of experiments to prove the truth of these ideas; and though it is now believed that his opinions are not well founded, he must be allowed to have expressed them, as well as their proofs, with a sagacity and philosophic distinctness at once convincing and uncommon. He examined the experiments of Richter, and found numbers different from his. He first disputed, but afterwards admitted, the mutual relation among bases observed already by Wenzel, though he attributed it to cohesive force, in other words, to crystallization.

A philosophical chemist requires to be seconded by the talent of wisely choosing his experiments, and of executing them with address; otherwise, perpetually deceived by them, he will build upon false foundations. So it has happened to this illustrious chemist. His experiments, viewed as exact analyses, have always given results extremely inaccurate, so that scarcely one of them is just; and in this point of view Berthollet has been still less fortunate than Richter. Berthollet observed, and proved indisputably, that elementary particles act not only according to the degree of their affinity, but also according to their mass. This phenomenon, however, does not happen except when the bodies that act, as well as the products of their mutual action, all continue mixed in solution, or under a liquid form. As Berthollet admits no other difference between solution and chemical combination but the degree of affinity, it seems probable that his mistake with regard to this point has occasioned all the rest.

It has lately been shown, by detailed and exact experiments, that Lavoisier was not wrong in considering these phenomena as different. It is known, for example, that pure lime and magnesia combine with water, for which they have a great affinity; but the one is very sparingly soluble in water, whilst the other is not soluble at all. Several bodies which contain great quantities of water in chemical combination, the metallic hydrates for example, the carbonates of various earths, &c. are not at all soluble in water; whilst other bodies which do not combine chemically with water are abundantly soluble in it; such as saltpetre, and culinary salt. When a substance combines chemically with water, it disengages caloric; when merely dissolved in water, its caloric is absorbed, and the temperature falls. A body possessing the property of combining with water, and at the same time soluble in it, first evolves heat, and afterwards cold. These entirely opposite phenomena must arise from a different cause; and consequently there must be some circumstance in solution which does not find place in chemical combination, or inversely.

M. Berthollet's opinions were first examined by M. Proust. He proved, from a series of ingenious experiments, that the new theory, when applied to any thing but solutions, and mixtures in a liquid state, led to considerable errors. It admitted, for example, that metals, in combining with oxygen, exhibit an infinite number of degrees of oxidation, between their minimum and maximum. Proust chose antimony and iron to show that this is not the case; and that, on the contrary, those metals do not combine with oxygen in more than two proportions; but that, if their minimum oxide is exposed to the action of oxygen, a portion being converted into the maximum oxide, remains mechanically mixed with the former. From which it appears, said Proust, that Berthollet has deceived himself by considering mechanical mixtures of the two oxides as particular degrees of oxidation. Proust extended his experiments to the metallic sulphurets, and found that a similar principle may be applied to them likewise; so that each new addition of oxygen or sulphur takes place *per saltum* without any intermediate stage. Berthollet defended himself with so much sagacity, that the impartial reader, though in the secret and perhaps obscure sentiment derived from a general survey of chemistry, he might decide for Proust, yet felt himself compelled to suspend his final judgment. Proust however enjoyed at last the triumph of observing that, in proportion as this department of science began to receive a more sedulous cultivation, as doubtful points were cleared up, the results obtained by impartial chemists confirmed his statement.

Some time before the works of Messrs. Richter and Berthollet appeared, Mr. Higgins, professor of chemistry at Dublin, in a publication named, *A Comparative View of the Phlogistic and Antiphlogistic Theories*, (1789,) started the idea of explaining the different degrees in which certain bodies combine,—azote and sulphur, for example, with oxygen,—by regarding them as united for each new degree of oxidation to an additional particle of oxygen; so that nitrous gas should contain two particles of oxygen, nitrous acid three, and nitric acid four particles, for each particle of azote. But as Mr. Higgins attached little importance to this happy idea, and applied it very sparingly, it excited no attention whatever among chemists.

About fifteen years later, Mr. Dalton, another English chemist, struck out the same idea; tried it by a comparison with the best analyses then known; and finding sufficient reasons to consider it as just, made it the basis of a chemical system, the details of which he published in a work, entitled, *A New System of Chemical Philosophy*, (1808.) According to this system, elementary substances combine together, in such a manner, that an atom or indestructible particle of the one always unites itself to 1, 2, 3, 4, &c. whole atoms of the other; each new addition taking place in a multiple ratio. Numerous experiments afterwards confirmed this hypothesis; none has contradicted it; and without exaggeration, it may be marked as one of the greatest improvements which chemistry has ever received. In his new system, Mr. Dalton supposes that elementary molecules unite most readily one to one; and hence, if but a single proportion is known in which two bodies unite, it must be considered as that of one atom to one atom. If several are known, the minimum of one element is considered as the proportion of one to one; the second as that of one to two, and so on. But when it happens that in the second combination the element added is multiplied only by 1½; the compound is looked upon as formed by two atoms of the one and three of the other. In the second volume of the work just quoted, (printed in 1810,) Mr. Dalton has examined the simple combustibles with their oxides, and given the number of atoms, which, in his opinion, those oxides must contain. To the method of Mr. Dalton, it may be objected that his principle is hypothetical; that he has shown little scruple in the application of it; that his analytical experiments are not always very exact; and that a desire, on the part of the operator, to obtain a preconceived result, seems often to have influenced the actual result; a circumstance which, in these researches, it is impossible too carefully to guard against, and which often misleads, above all, when the system is framed first, and the proofs sought afterwards. Mr. Dalton's new system is, moreover, mingled, like the work of M. Richter, with results less solidly founded; to which, no less than his predecessor, he has endeavoured to add probability by giving them a mathematical colour. Mr. Dalton was even of opinion that he had found the mathematical laws, according to which gasiform substances are absorbed and retained by liquids. He speaks of having determined by experiments, which are very exact, and, to judge from his own account of them, very conclusive, that gases, excepting such as disengage a great quantity of caloric in combining with water, are absorbed by that substance, either in a volume equal to that of the water, or else in a volume equal to $\frac{1}{8}$, $\frac{1}{27}$, or $\frac{1}{64}$ of that of the water. These numbers being the cubes of $\frac{1}{1}$, $\frac{1}{2}$, $\frac{1}{3}$, and $\frac{1}{4}$, he infers that the distance betweeen the molecules of gasiform substances, absorbed by water, is always some multiple of their distance when out of water. Every liquid absorbs the same quantity of gas as water; with this single difference, that viscous liquids require more time for saturation.

Yet upon repeating those experiments, with all possible care as it would seem, M. de Saussure has just found that Mr. Dalton's results are without foundation; and that not only different liquids absorb different quantities of the same gas, but that even the same liquid, mixed with a substance soluble in it, loses much of its absorbent power. Nor has the ratio which, according to Mr. Dalton, the volume of the absorbed gas bears to that of the absorbent liquid, been better confirmed by the experiments of De Saussure. The following is a comparison between some of their results.

100 measures of water absorb of

	(According to Saussure.)	*(According to Dalton.)*	
Carbonic acid gas,	106	100	= 1 Volume.
Sulphurated hydrogen gas,	253	100	= 1
Nitrous oxide gas,	76	100	= 1
Olefiant gas,	15.5	12.5	= $\frac{1}{8}$
Oxygen gas,	6.5	3.7	= $\frac{1}{27}$
Nitrogen gas,	4.0	1.56	= $\frac{1}{64}$

These differences serve to show how science may be injured, when the cultivator of it is one who, with little accuracy in experimenting, possesses great confidence in his own labours, and enough of sagacity to diffuse a mathematical plausibility over his results. It is much to be feared, that, notwithstanding the new information which we owe to the doctrine of chemical proportions, the abuse made of that principle by unscrupulous chemists may occasion very considerable mistakes.

Mr. Dalton's opinions at first excited little interest; but some experiments of Dr. Wollaston awakened the attention of chemists. It is a necessary consequence from the atomic system of Mr. Dalton, that if A can combine with B in more than one proportion, the latter must be 2, 3, &c. times B. Wollaston weighed a portion of the superoxalate of potass, and expelled its acid by fire. The potass that remained, when added to a portion of the superoxalate, equal to that which had just been burned, rendered it exactly neutral. Another portion of the superoxalate being dissolved in diluted muriatic acid, and evaporated to crystallization, produced a superoxalate with a greater excess of acid. Having roasted a certain quantity of it, he now observed how much of the same salt not burned was required to neutralize the potass obtained; three parts of the burned potass were required to saturate one part of the unburned maximum superoxalate. From these experiments, no less simple than ingenious, it follows that potass combines with three portions of oxalic acid, bearing to one another the ratio of 1, 2, and 4. Wollaston subjoined some other experiments, the results of which were likewise conformable to Dalton's hypothesis.

Gay Lussac.

In their investigation concerning eudiometry, Messrs. Humboldt and Gay Lussac had found, that the gasiform elements of water combine in such a proportion, that exactly two volumes of hydrogen are required to saturate one volume of oxygen. M. Gay Lussac, continuing his researches, discovered that gases in general combine in such a manner as to have a volume of the one united either to a volume of the other, or to some multiple or submultiple of that volume. His memoir on the mutual combination of gaseous substances is to be found in the *Mémoires d'Arcueil*, t. ii. 1809. These experiments prove, in the most direct manner, that Dalton's idea is just, if only the word volume be substituted for atom. M. Gay Lussac did not, however, make any more general application of this precious discovery. It had been said in the *Statique* of Berthollet, that gasiform substances must combine in fixed proportions, because they suffer a great condensation in that process; and M. Gay Lussac contented himself with having found the law of these proportions,—a more extensive application of which would doubtless have widely changed M. Berthollet's manner of conceiving the subject, in which Gay Lussac seems then to have agreed with him. Mr. Dalton, instead of hailing the triumph offered him by this discovery, struggled, on the contrary, to dispute its correctness. He had grounded his calculations on the idea that water is formed by one atom of each of its elements; and denoting the relative weight of the atoms, he had put that of hydrogen the lightest, =1. If, on the other hand, M. Gay Lussac's opinion was just, it seemed much more natural to regard water as containing two atoms of hydrogen. Mr. Dalton drew *Profile Views of the Disposition and Arrangement of Particles constituting Elastic Fluids, both Simple and Compound*; and, finally, combined some experiments to prove, that two gases are never condensed in the proportions assigned by M. Gay Lussac. Yet in perusing Mr. Dalton's work, an experienced reader will think he finds, even in comparing the results with those of Gay Lussac, new proofs in favour of the laws established by the latter. At present, the generality of chemists appear to admit that Gay Lussac's observations agree with experience.'

Gay Lussac likewise examined the precipitation of metals, in their metallic state, by other metals. The results of his examination confirm what Bergman and Richter had already advanced on this subject.

Berzelius.

But the most detailed and extensive course of experiments concerning chemical proportions has been performed by M. Berzelius of Stockholm. The works of Richter had engaged this chemist to repeat the experiments detailed in them, and correct their results. He endeavoured to obtain data sufficiently exact for enabling him to calculate, according to the rules established by Richter, the composition of most saline bodies. During this enterprise, the late analysis of the alkalies induced him to give greater compass to his researches, in order to determine the quantity of oxygen contained in those bodies, and chiefly in ammonia, by means of what Bergman, and still more what Richter had discovered concerning the precipitation of metals by each other. These experiments presented difficulties at the very outset. Assuming as a groundwork those analyses, which he had every reason to consider as the best, he found them rather to contradict than to confirm the laws already looked upon as proved. But having studied to observe and avoid every circumstance which might affect the result of an analysis, he obtained at last a certain number of analytical results, exact enough to correspond with the laws under consideration. Of all the analyses performed before him, none but those of Wenzel were found to coincide with his own. The experiments of Dr. Wollaston, concerning the multiple proportions of Dalton, having been published in the *Philosophical Transactions*, (1808,) M. Berzelius here entered upon a new field, deserving more minute examination. The first series of M. Berzelius' experiments was printed in a Swedish periodical work, conducted by himself, along with M. Hisinger, and entitled, *Afhandlingar i Fysik, Kemi och Mineralogi*. The various memoirs which he afterwards published on this subject, are to be met with in the different journals of physics and chemistry; such as Dr. Thomson's *Annals of Philosophy*; Mr. Nicholson's *Journal*; Mr. Tilloch's *Philosophical Magazine*; the *Annales de Chymie*; the *Journal de Physique*; M. Gilbert's *Annalen der Physik*; M. Schweigger's *Journal*; no one of which, however, contains the complete collection. It would be tedious in this place to exhibit the entire series of his experiments on chemical proportions; it is enough to mention, that in order to arrive at the results, of which we are immediately to present an exposition, he examined nearly all the oxides having simple radicals; many saline combinations, among the greater part of acids and bases, having an excess of base, or existing in a neutral state; a multitude of salts, with two bases, as well as salts with two acids; the chemical combinations of water with acids, bases and salts; some combinations of metals with each other, and of metallic oxides with each other; he extended his researches to minerals, of which he analyzed several himself, and examined the analyses made of others by the most celebrated chemists of our age; and, finally, he likewise analyzed some vegetables. The experiments of M. Berzelius differ from those of the chemists already mentioned, in not having been made to establish any preconceived hypothesis. On the contrary, they form a course of study regarding determinate proportions, from which the laws have emerged by degrees, as the facts including them augmented in number. From his experiments, M. Berzelius concludes, that the laws, according to which elementary substances combine, may, in so far as concerns *inorganic nature*, be reduced to two principal rules. *First*, when a body A combines with a body B in several proportions, the numbers expressing those proportions are integer multiples of the smallest quantity of B that A can absorb; so that if this quantity of B were = 6, the other proportions must be some of the following: 24, 36, 48, &c. It is from this law that Mr. Dalton's hypothesis acquires so much probability. *Secondly*, when two oxidized bodies combine, the oxygen of the one is an integer multiple of that contained by the other; or if the number of oxidized bodies is greater, the oxygen of the body containing least is an integer submultiple of the oxygen found in any of the rest. In the sulphate of potass, for example, the oxygen of the sulphuric acid is three times that of the potass; and in crystallized alum the oxygen contained by the potass, which is the smallest quantity, is a submultiple by three of that contained by the alumina, by 12 of that contained by the sulphuric acid, and by 24 of that contained by the water of crystallization. This last rule, however, may be expressed in a more general manner: Two compound bodies, the electro-negative element of which is common, combine in such a ratio, that the quantity of that common element contained by the one is an integer multiple of the quantity contained by the other; or when the number of compound bodies is greater, &c. &c. It is conformable to this law, that in fossil combinations of the different metallic sulphurets, the sulphur of the one is always a multiple of that of the other. It happens sometimes that compound bodies, of which the electro-positive element is common, may enter into combination. Those combinations have been little examined; but it appears that the electro-negative elements divide the electro-positive one among them, in some multiple proportion. Such, for example, are mispickel, compounded of sulphuret and arseniate of iron, in which the iron is equally divided between the sulphur and the arsenic; the double salt having for its base the oxide of lead, combined with nitric acid and phosphoric acid; in which the latter occupies twice as much of the base as the former.

From these two laws are deduced all the phenomena of chemical proportions. Sulphuric acid, for example, contains three times as much oxygen as the base by which it is neutralized. Hence when any sulphate of a metallic oxide is decomposed by another metal, the latter precipitates the dissolved metal under a metallic form, without altering its neutrality, because the sulphuric acid must, as formerly, contain three times the oxygen of the metal last dissolved, and therefore the oxygen remains without alteration, nothing but the metallic radical being changed. Now, since the relation between the oxygen of the base and that of the acid is invariable, with regard to all neutral salts of the same acid, the constant ratio in the capacity of bases to saturate acids, observed and proved by Wenzel and Richter, follows as a necessary consequence from this fact; and such neutral salts as mutually decompose each other must, therefore, still maintain their neutrality. If, on the contrary, which rarely happens, the ratio between the oxygen of the base and that of the acid is different for different bases, two neutral salts may happen from this circumstance to decompose each other, and at the same time lose their neutrality (as the muriate of glucina and the fluate of soda, the carbonate of potass and muriate of lime, sulphate of ammonia and muriate of barytes) without however being in opposition to the above laws; for in such cases the oxygen of the base becomes a submultiple of that of the acid by a different number.

Yet the two principal rules just mentioned are not absolutely without exception. Sulphur, in particular, forms an exception to the first. In the case of this substance we are acquainted with no more than two degrees of oxidation, the highest of which, sulphuric acid, contains but 1½ time as much oxygen to the same quantity of sulphur, as the lower degree, sulphurous acid. The same is the fact with regard to iron. Antimony also has several degrees of oxidation, the second of which contains but 1½ time as much oxygen as the first. It is quite possible, however, that these exceptions may be apparent only. They would in fact be so, should it be found that there are other lower degrees of oxidation not yet discovered, or not capable of existing in the isolated state. It is thus we have reason to consider sulphur combined with oxymuriatic gas as being in the state of an oxide, the oxygen of which, found by calculation, is exactly one-half of that contained in sulphurous acid. If this is really the case, the degrees in which sulphur unites with oxygen are to each other as 1, 2, and 3. In like manner, the protoxide of iron may contain two times, and the protoxide of antimony three times, as much oxygen as exists in some first degree of oxidation not yet discovered.

The exceptions to the second rule are fewer in number, but at the same time more striking and worthy of attention. In the greater part of those combinations among oxidized bodies hitherto analyzed, none but the oxides of two individual radicals have been found to contradict this rule. The oxides in question are those which have nitrogen and phosphorus as radicals. Nitrogen and phosphorus combine with oxygen in different degrees, the last two of which are acids. In the case of other radicals giving two acids, the ratio of the oxygen contained by the acid in its higher state of oxidation, to that contained by the acid in its lower state of oxidation, is as 2 to 3; in the case of nitrogen and phosphorus as 3 to 5. M. Berzelius attempts to explain these deviations in the following manner. The composition of neutral nitrates is conformable to the rule so far that the acid contains five times as much oxygen as the base; but the composition of subnitrates, three different degrees of which he has examined, varies from it; the oxygen of the first subnitrate being a multiple by 2½ of that contained by the base; in the second, a multiple by 1⅔; in the last, a multiple by 1⅕. Comparing these fractions with each other, and with the numerous analytical results, so exactly conformed to the rule, it would seem that some unknown circumstance has in this case produced an exception, not real but apparent. If the supposition so long entertained, that nitrogen is not a simple body, be in truth well founded, these aberrations are capable of being easily and fully explained. One volume of nitrogen gas combines, in its different oxides, with ½, 1, 1½, and 2½ volumes of oxygen gas; from which it follows that if nitrogen really contains oxygen, it can only contain the half of its volume; so that nitrogen would, on this supposition, be composed of one volume of a radical, unknown in its isolated state, and one volume of oxygen. Upon this hypothesis, the different degrees of oxidation which a volume of this radical admits, are produced by adding a volume of oxygen gas according to the following series: 1, 2, 3, 4, and 6; a series far more natural than the first. Now, as nitric acid contains six volumes of oxygen, the nitrates and subnitrates mentioned above no longer form exceptions to the rule; for in neutral nitrates the oxygen of the acid is six times that of the base; in the first two subnitrates, three and two times that of the base; and finally, in the last subnitrate, the oxygen of the acid is equal in quantity to that of the base. This mode of viewing the composition of nitric acid becomes still more plausible, when the composition of ammonia is examined. This alkali has the closest analogy with the fixed alkalies, in all its properties, even in the method by which it is reduced to a metallic body, in the circuit of the electric pile. Its composition must, therefore, in like manner, be analogous to theirs; and if the former bear to the latter such a relation, for example, as the composition of acetic bears to the composition of sulphuric acid, we are naturally led to suppose in ammonia the existence of a quantity of oxygen capable of being calculated from the quantities of ammonia necessary for displacing, from its combination with an acid, another oxide, the quantity of whose oxygen is known. In neutral carbonates, proportional to the neutral carbonate of ammonia, the carbonic acid contains four times the oxygen of the base; while this carbonate of ammonia contains equal volumes of carbonic acid and ammoniacal gas. Now, since the carbonic acid gas contains a volume of oxygen gas equal to its own volume, the ammonia must contain a quantity of oxygen equal to the fourth part of its volume. But in a volume of ammoniacal gas the half is nitrogen; and agreeably to what is said above, nitrogen ought to have the half of its volume (the fourth part of the ammonia's volume) composed of oxygen gas; and thus our examination of ammonia leads to the same conclusion with regard to the composition of azote, as the examination of nitric acid. In this way, it is easy to conceive how ammonia by the action of the pile may be decomposed into oxygen, and a body analogous to metals, whilst the deoxidated radical of azote, combined with the hydrogen, is retained by its affinity to the mercury, which serves as negative conductor. This reasoning, it cannot be denied, possesses considerable probability; and though nothing is proved by it, still it seems more likely that azote will be found to be a compound body than a simple one. As to the exceptions occurring in the case of phosphoric acid, a similar explanation would serve, if it were in our power to prove that phosphorus, like azote, contains oxygen. In neutral phosphates, the acid contains $2\frac{1}{2}$ times as much oxygen as the base; in sub-phosphates $1\frac{2}{3}$ time as much. If phosphoric acid, instead of 5, contained 6 portions of oxygen, one of them being concealed in the phosphorus; then the acid in neutral phosphates would contain three times as much oxygen as the base, in subphosphates two times as much. M. Berzelius combined phosphorus with iron, and caused the rod so obtained to be oxidated by muriatic acid; but he found that, in the phosphuret of iron, the phosphorus gives exactly the same quantity of phosphoric acid as an equal quantity of common phosphorus; so that phosphorus either does not contain any oxygen, or combines with combustible bodies without losing it, just as the fixed alkalies and the earths, for instance, may combine with sulphur and boron, without losing their oxygen. For the present, then, it is proper to rest satisfied with observing and studying these exceptions, without pretending to the power of explaining or removing them.

What has now been said relates merely to the facts observed. In chemical philosophy it is farther requisite to try if an account can be given why the facts are thus and not otherwise. Some memoirs of M. Berzelius have had in view to examine the cause of chemical proportions. "Whenever we begin to consider this matter," he observes, "it is evident, at first sight, that the cause cannot be any thing else than of a mechanical nature; and the idea, which seems most probable and best suited to the views suggested by experience, is that bodies are composed of molecules or atoms, which combine one with one, 1 with 2, 3, 4, &c.: and the laws of chemical proportions appear to result from this principle, in a manner so clear and evident, that it seems strange how an idea so simple and rational should have failed, not only to be adopted, but even to be stated till our own age." This hypothesis gains an additional degree of credibility when applied to those electro-chemical facts, by which we have just learned that all the phenomena of affinities are, in truth, nothing more than phenomena of an electric action, between the bodies mutually combined or decomposed. Supposing those atoms or elementary molecules, of which bodies are formed, to be endowed with an electric polarity, by which their affinities are exercised, we are enabled to comprehend how the forces, named chemical affinities, may be the same as the two opposite electric states, named + E and — E. By this means, the phenomena of chemical proportions will not be difficult to understand, if we admit that molecules combine one atom or molecule with one or several elementary molecules; and a corpuscular theory that shall not omit the forces on which the combinations of molecules depend, will henceforth constitute the basis of chemistry and physics; whether, in fact, this theory be a true exposition of the nature of things, or only a mode of representation, enabling us to know and comprehend what otherwise must have remained inexplicable and undiscovered. Now, if experience has begun to ratify such a representation of the intimate composition of bodies, the second step will be to attempt discovering the number of molecules belonging to each element in each combination. Researches of this kind are doubtless extremely difficult, their first results will perhaps at best be doubtful, yet still it is plain, that any supposition as to this point, if taken up at hazard, cannot have the smallest value. Mr. Dalton was the first who attempted to compute the molecules of the elements existing in several compound inorganic bodies. He set out, on this investigation, from a principle altogether artificial. We have already mentioned, that, when there is but one known combination of two elementary bodies, Mr. Dalton considers it as containing a molecule of each element; but that when there are two or more combinations, he allows himself to be guided by the proportion subsisting between them. Experience, however, daily shows that we are not yet acquainted with all the degrees of combination; and when it happens that of several possible degrees of combination we have discovered but a single one, nothing can assure us that this must be precisely the degree, which contains only a single molecule of each of its elements. It is impossible then, according to Berzelius, that Mr. Dalton's application of the corpuscular hypothesis can ever give satisfactory results. To discover the number of molecules in oxidized bodies, M. Berzelius made use of two circumstances. He examined (*a*) the different degrees of oxidation in some one radical. Suppose that of the several possible oxides of this radical, but two are known; their quantities of oxygen being in the ratio 2 to 3, of 3 to 4, or of 4 to 5, he infers that these oxides contain also this number of molecules; for otherwise (granting always the hypothesis of molecules) one of them would contain a fraction of a molecule, which is not admissible. Combining (*b*) any oxide with another oxide, which may serve as a (saline) base to it, or which, in respect of it, is electro-negative,—most frequently it happens that the oxygen contained in the electro-negative oxide is a multiple by 2, 3, 4, &c. of the oxygen contained in the electro-positive oxide. It follows next that the number must be such as to introduce no fraction of a molecule into the electro-negative oxide. An oxide of A, for example, which contains 3 molecules of oxygen,—if it be combined with another B, so that A contained 4 times as much oxygen as B,—would always presuppose a fraction of a molecule to exist in the radical of A. But, in examining the combinations of oxides with each other, in their different degrees of mutual saturation, Berzelius has lately found that both the circumstances (*a* and *b*) lead always to the same result; and that, from their coincidence, the number of mole-

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cules in the greater part of oxides may be inferred with considerable certainty. It follows that most of the oxides which, according to Dalton, contain only 1 molecule of oxygen, contain in reality 2 or 3. Yet there are oxides, the number of whose molecules cannot be determined by any experiment; such are potass and the earths in general. Berzelius has attempted to supply this deficiency by a train of analogical reasoning, which, though it no doubt occasionally misleads, is in this case the only clue we have to guide us. The analogy of potass to soda induces a supposition that, in each of those two alkalies, the number of atoms is the same; but we know, from analysing the superoxide of soda, that this alkali must contain 2 molecules of oxygen; from which, we may perhaps conclude, that potass contains 2 likewise. Besides, on comparing together those metallic oxides which are electro-positive, (that is to say, which give salts with acids,) it appears that such as contain 2 molecules of oxygen form always the strongest saline base, and show the closest analogy to alkalies. Such as contain but one molecule, either do not at all combine with acids, or constitute a separate class of saline bases; they have a strong mutual resemblance in their general properties, and their salts differ in a characteristic manner from those of oxides containing 2 molecules of oxygen: such are the minimum oxides of copper, of mercury, platina, rhodium, and gold. With regard to such as contain 3 molecules of oxygen, they likewise, in general, form weaker saline bases, and even frequently, in the state of electro-negative oxides, themselves combine with saline bases. From all this, Berzelius concludes, that, for the present, the fixed alkalies and the earths may, with most plausibility, be looked upon as containing 2 molecules of oxygen. As to alumina, on examining the proportions in which this earth is found combined with potass in alum and feldspar, with magnesia and the oxide of zinc, in the spinelle and gahnite, Berzelius imagined it to contain 3 molecules of oxygen. The same is probably true of glucina.

To express the composition of a compound body, M. Berzelius has proposed signs, by means of which, a glance will suffice to show what otherwise must have required a long periphrase to enunciate. Each radical is represented by the initial of its Latin name. If two radicals have the same initial letter, they are distinguished in the following manner. Combustible bodies, not metallic, are designated by the first letter alone; such metals as have the same initial being distinguished by a second letter. Thus *C* denotes carbonium; *Co.* = cobaltum; *Cu.* = cuprum; *Sn.* = stannum; *Sb.* = stibium; *O* signifies oxygen; but as in compound bodies it is a more general ingredient than any other element, Berzelius proposes to mark the number of its atoms by dots placed above the initial letter. Thus, for example, $\ddot{C} = C + 2\,O =$ carbonic acid; $\dddot{Fe} = Fe + 3\,O =$ red oxide of iron. This expedient renders the formulae shorter and more easily understood. When a compound body contains several molecules of a combustible element, the number of its atoms is annexed on the right, like an exponent in algebra. Thus, $\dddot{Al}.\,\dddot{S}.^3 =$ sulphate of alumina; means that there are three molecules of sulphur or sulphuric acid for one of alumina; but if it were required to denote that a body contains, for example, two particles of the sulphate of alumina, the number is placed on the left; and it then multiplies all the letters which follow it. Thus, $\ddot{K}.\,\dddot{S}.^2 + 2\,\dddot{Al}.\,\dddot{S}.^3$ is the formula, exhibiting the composition of alum. To determine the relative weight of the molecules, Berzelius compares them with that of oxygen, supposed to be unity; a method which has likewise been proposed by Dr. Wollaston. The number of molecules contained in an oxide being known, it is easy to find the weight of a molecule of the radical. The oxide of iron, for instance, is composed of 100 parts iron, and 44.25 parts oxygen: these 44.25 parts form three molecules of oxygen; from which it follows that $\frac{44.25}{3} : 100 :: 1$, (the weight of oxygen,) : 6.78, the weight of the molecule of iron. M. Berzelius has given the following table, exhibiting the weight of the several radicals, and the composition as well as weight of their oxides.

Latin Names.	Sign or Formula of Composition.	Weight of the Molecule.
I. ELEMENTARY BODIES.		
Oxygenium	*O.*	1.000
Sulphuricum	*S.*	2.010
Phosphoricum	*P.*	3.901
Muriaticum (radical of Muriatic Acid)	*M.*	1.395
Fluoricum (radical of Fluoric Acid)	*F.*	0.600 ?
Boracicum	*B.*	0.732
Carbonicum	*C.*	0.750
Nitricum (radical of Azote)	*N.*	0.795
Hydrogenium	*H.*	0.0636
Arsenicum	*As.*	8.399
Molybdenium	*Mo.*	6.015
Chromium	*Ch.*	7.030
Wolframium	*W.*	24.242
Tellurium	*Te.*	8.064
Stibium	*Sb.*	16.130
Tantalum	*Ta.*	18.231
Silicium	*Si.*	3.018
Rhodium	*R.*	14.903
Platinum	*Pt.*	12.067

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Table Continued.

Latin Names.	Sign or Formula of Composition.	Weight of the Molecule.
Aurum	*Au.*	24.838
Palladium	*Pl.*	14.180
Hydrargyrum	*Hy.*	26.881
Cuprum	*Cu.*	8.064
Niccolum	*Ni.*	7.388
Cobaltum	*Co.*	7.326
Bismutum	*Bi.*	17.740
Plumbum	*Pl.*	25.974
Stannum	*Sn.*	14.706
Ferrum	*Fe.*	6.780
Zincum	*Zn.*	8.064
Manganium	*Mn.*	7.115
Uranium	*U.*	39.404
Cerium	*Ce.*	11.488
Yttrium	*Y.*	8.816
Beryllium (Glycium)	*Be.*	6.833
Aluminium	*Al.*	3.430
Magnesium (Magnium of Davy)	*Ms.*	3.154
Calcium	*Ca.*	5.102
Strontium	*Sr.*	14.101
Barytium	*Ba.*	17.091
Natrium	*Na.*	5.793
Kalium	*K.*	9.780
II. OXIDES.		
Acidum Sulphuricum	$\dddot{S} = S + 3\,O$	5.010
Sulphurosum	$\ddot{S} = S + 2\,O$	4.010
Phosphoricum	$\overset{\cdot\cdot\cdot\cdot\cdot}{P} = P + 5\,O$	8.901
Phosphorosum	$\dddot{P} = P + 3\,O$	6.901
Muriaticum	$\dot{M} = M + 2\,O$	3.395
Superoxidum Muriatosum (Oxym. Gas)	$\ddot{M} = M + 3\,O$	4.395
Muriaticum (Euchlorine)	$\ddddot{M} = M + 4\,O$	5.395
Acidum Oxymuriatosum	$\overset{:::}{M} = M + 6\,O$	7,395
Oxymuriaticum	$\overset{::::}{M} = M + 8\,O$	9.395
Suboxidum Nitricum (Azote)	$\dot{N} = N + O$	1.795
Oxidum Nitrosum	$\ddot{N} = N + 2\,O$	2.795
Nitricum (Nitrous Gas)	$\dddot{N} = N + 3\,O$	3.795
Acidum Nitrosum	$\ddddot{N} = N + 4\,O$	4.795
Nitricum	$\overset{:::}{N} = N + 6\,O$	6.795
Fluoricum	$\ddot{F} = F + 2\,O$	2.600
Boracicum	$\ddot{B} = B + 2\,O$	2.732
Suboxidum Carbonicum (oxide of carbon)	$\dot{C} = C + O$	1.750
Acidum Carbonicum	$\ddot{C} = C + 2\,O$	2.750
Aqua	$H^2O = H + 2\,O$	1.135
Acidum Arseniosum	$\ddddot{As} = As + 4\,O$	12.399
Arsenicicum	$\overset{:::}{As} = As + 6\,O$	14.399
Oxidum Molybdicum	$\dot{Mo} = Mo + O$	7.015
Acidum Molybdosum	$\ddot{Mo} = Mo + 2\,O$	8.015
Molybdicum	$\dddot{Mo} = Mo + 3\,O$	9.015
Oxidum Chromosum (green)	$\dddot{Ch} = Ch + 3\,O$	10.080
Chromicum (brown)	$\ddddot{Ch} = Ch + 4\,O$	11.080
Acidum Chromicum	$\overset{:::}{Ch} = Ch + 6\,O$	13.080
Oxidum Wolframicum	$\ddddot{W} = W + 4\,O$	28.242
Wolframicum	$\overset{:::}{W} = W + 6\,O$	30.242

Proportions, Determinate.

Table Continued.

Latin Names.	Sign or Formula of Composition.	Weight of the Molecule.
Oxidum Stibicum	$\dddot{Sb} = Sb + 3\,O$	19.130
Acidum Stibiosum	$\ddddot{Sb} = Sb + 4\,O$	20.130
Stibicum	$\overset{:::}{Sb} = Sb + 6\,O$	22.130
Oxidum Telluricum	$\ddot{Te} = Te + 2\,O$	10.064
Silicia	$\dddot{Si} = Si + 3\,O$	6.048
Oxidum Rhodosum	$\dot{R} = R + O$	15.903
Rhodeum	$\ddot{R} = R + 2\,O$	16.903
Rhodicum	$\dddot{R} = R + 3\,O$	17.903
Platinosum	$\dot{Pt} = Pt + O$	13.067
Platinicum	$\ddot{Pt} = Pt + 2\,O$	14.067
Aurosum	$\dot{Au} = Au + O$	25.838
Auricum	$\dddot{Au} = Au + 3\,O$	27.838
Palladicum	$\ddot{Pa} = Pa + 2\,O$	16.180
Hydrargyrosum	$\dot{Hg} = Hg + O$	26.316
Hydrargyricum	$\ddot{Hg} = Hg + 2\,O$	27.316
Argenticum	$\ddot{Ag} = Ag + 2\,O$	28.881
Cuprosum	$\dot{Cu} = Cu + O$	9.064
Cupricum	$\ddot{Cu} = Cu + 2\,O$	10.064
Niccolicum	$\ddot{Ni} = Ni + 2\,O$	9.338
Superoxidum Niccolicum	$\dddot{Ni} = Ni + 3\,O$	10.338
Oxidum Cobalticum	$\ddot{Co} = Co + 2\,O$	9.326
Superoxidum Cobalticum	$\dddot{Co} = Co + 3\,O$	10.326
Oxidum Bismuticum	$\ddot{Bi} = Bi + 2\,O$	19.740
Plumbicum (Litharge)	$\ddot{Pb} = Pb + 2\,O$	27.974
Superoxidum Plumbosum (Minium)	$\dddot{Pb} = Pb + 3\,O$	28.974
Plumbicum	$\ddddot{Pb} = Pb + 4\,O$	29.974
Oxidum Stannosum	$\ddot{Sn} = Sn + 2\,O$	16.706
Stanneum	$\dddot{Sn} = Sn + 3\,O$	17.706
Stannicum	$\ddddot{Sn} = Sn + 4\,O$	18.706
Ferrosum	$\ddot{Fe} = Fe + 2\,O$	8.780
Ferricum	$\dddot{Fe} = Fe + 3\,O$	9.780
Zincicum	$\ddot{Zn} = Zn + 2\,O$	10.064
Manganosum	$\ddot{Mn} = Mn + 2\,O$	9.115
Manganicum	$\dddot{Mn} = Mn + 3\,O$	10.115
Superoxidum Manganicum	$\ddddot{Mn} = Mn + 4\,O$	11.115
Oxidum Uranosum	$\ddot{U} = U + 2\,O$	32.414
Uranicum	$\dddot{U} = U + 3\,O$	33.414
Cerosum	$\ddot{C} = C + 2\,O$	13.488
Cericum	$\dddot{Ce} = C + 3\,O$	14.488
Yttria	$\ddot{Y} = Y + 2\,O$	10.816
Beryllia	$\dddot{Be} = Be + 3\,O$	9.833
Alumina	$\dddot{Al} = Al + 3\,O$	6.430
Magnesia	$\ddot{Mg} = Mg + 2\,O$	5.154
Calcia	$\ddot{Ca} = Ca + 2\,O$	7.102
Strontia	$\ddot{Sr} = Sr + 2\,O$	16.101
Barytia	$\ddot{Ba} = Ba + 2\,O$	19.091
Natrum (Soda)	$\ddot{Na} = Na + 2\,O$	7.793
Superoxidum Natricum	$\dddot{Na} = Na + 3\,O$	8.793
Kali (Potass)	$\ddot{K} = K + 2\,O$	11.780
Superoxidum Kalicum	$\overset{:::}{K} = K + 6\,O$	15.780

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For the sake of such as may wish to employ those numbers in exhibiting the composition of saline bodies, we shall add the following Table, containing some examples, according to which all the other salts may be compounded.

Names.	Formulæ.	Weight.
Sulphate of Potass (Sulphas Kalicus) .	$\ddot{K}\,\dddot{S}^2$	21.8
Sulphate of Iron (Sulphas Ferrosus) . .	$\ddot{Fe}\,\dddot{S}^2$	18.8
Sulphate of Oxide of Iron (Sulphas Ferricus) .	$\dddot{F}\,\dddot{S}^3$	24.81
Subsulphate of Oxide of Iron (Subsulph. Ferricus)	$\dddot{Fe}^2\,\dddot{S}$	24.57
Sulphite of Potass (Sulphis Kalicus) .	$\ddot{K}\,\ddot{S}^2$	15.79
Nitrate of Mercury (Nitras Hydrargyrosus) .	$\dot{Hg}\,\overset{:::}{N}$	33.11
Nitrate of Lead (Nitras Plumbicus) . . .	$\ddot{Pb}\,\overset{:::}{N}^2$	43.56
Subnitrate of Lead, first	$\ddot{Pb}\,\overset{:::}{N}$	36.77
second . . .	$\ddot{Pb}^3\,\overset{:::}{N}^2$	103.51
last . . .	$\ddot{Pb}^3\,\overset{:::}{N}$	96.71
Phosphate of Soda (Phosphas Natricus) .	$\ddot{Na}\,\overset{..}{\overset{...}{P}}$	16.69
Phosphate of Soda, crystallized . . .	$\ddot{Na}\,\overset{..}{\overset{...}{P}} + 24\,H^2O$	43.93
Subphosphate of Silver . . .	$\ddot{Ag}^3\,\overset{..}{\overset{...}{P}}^2$	104.44
Phosphite of Soda	$\ddot{Na}\,\dddot{P}$	14.69
Muriate of Ammonia . .	$\dot{N}^6\,N\,\ddot{M} + N^2\,O$	6.68
Muriate of Lead	$\ddot{Pb}\,\ddot{M}^2$	34.76
Submuriate of Lead	$\ddot{Pb}^2\,\ddot{M}$	68.34
Oxymuriate of Potass	$\ddot{K}\,\overset{::::}{M}$	30.57
Neutral Carbonate of Potass .	$\ddot{K}\,\ddot{C}^4$	22.78
Subcarbonate of Potass	$\ddot{K}\,\ddot{C}^2$	17.28
Fluate of Lime	$\ddot{Ca}\,\ddot{F}^2$	12.30
Borate of Magnesia	$\ddot{Mg}\,\dddot{B}^4$	16.07
Oxidized Arseniate of Copper (Arsenias Cupricus)	$\ddot{Cu}\,\overset{.}{\overset{:::}{As}}$	24.46
Subarseniate of Copper (Subarsenias Cupricus)	$\ddot{Cu}^3\,\overset{:::}{As}^2$	58.99
Molybdate of Lead	$\ddot{Pb}\,\dddot{Mo}^2$	48.00
Chromate of Lead	$\ddot{Pb}\,\overset{:::}{Ch}$	43.05
Wolframiate of Lime	$\ddot{Ca}^2\,\overset{:::}{W}$	42.44
Alum	$\ddot{K}\,\dddot{S}^2 + 2\,\ddot{Al}\,\dddot{S}^3 + 48\,H^2\,O$	119.07
Sulphate of Ammonia and Magnesia . .	$\ddot{Mg}\,\dddot{S}^2 + 2\,\dot{N}^6\,O\,\dddot{S}$	29.5
Nitrate and Phosphate of Lead . . .	$\ddot{Pb}\,\overset{:::}{N}^2 + 2\,\ddot{Pb}\,\overset{..}{\overset{...}{P}}$	121.3

But we have still to discuss a very important point in regard to the corpuscular hypothesis, and its application to observed facts. Admitting that bodies are composed of entire atoms, in all the following modes: 1 A for example with 1 A, 2 A with 3 B, 3 A with 4 B, or 5, or 7, or 8, or 9 B, 9 A with 10 B, and lastly 99 A with 100 B; it follows, that combinations may take place according to an almost infinite number of proportions, the differences of which would finally become such, that no analysis could be exact enough to discover them. This, however, does not, in fact, take place; consequently the molecules cannot combine, (at least in the case of inorganic substances,) in all numbers whatever; and, therefore, it is necessary to inquire what are the proportions, according to which the molecules of elementary bodies are found actually combined. On surveying the analyses hitherto made of inorganic substances, Berzelius thinks he has found that nearly all of them are compounded in such a way, that one of the elements occurs only in a single molecule; and from this fact he has drawn the conclusion, that such substances are characterized in their composition by the circumstance of one element, in comparison with the rest, always entering by a single molecule.

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Some exceptions to this rule were at first considered by him as proceeding from our inadequate acquaintance with the number of molecules in such bodies; but after a more comprehensive examination, he is of opinion, that there exist combinations of two molecules of one element, with three of another; which, however, he inclines to believe do not occur between two elements alone, but require the presence of a third to effect their union. Thus the subsulphate of oxide of copper is composed of $3\,\dot{Cu}. + 2\,\dddot{S}$, whilst no combination of $3\,Cu. + 2\,S$, is known to exist, or can exist, as Berzelius thinks; because nothing more than a force purely mechanical seems requisite to divide it into one molecule of $S + C$, and one of $S + 2\,C$. *A priori*, it cannot be decided whether, in the compass of inorganic nature, molecules do not combine in still more complicated numbers; such as $3\,A + 4\,B$, $3\,A + 5\,B$, &c. &c.; but so far as actual experience allows us to decide, it is reasonable to suppose that no such combinations occur. On attempting to discover the cause why the molecules, in all inorganic substances, combine only according to proportions so limited, we arrive at certain boundaries, over which it is not permitted for the present to extend the empire of science. We cannot explain how it happens, that if oxygen be added to a solution, say of $\ddot{Fe}\,\dddot{S}^2$ (= the subsulphate of the protoxide of iron,) there results not an $\dddot{Fe}\,\dddot{S}^3$, but a division of the compound into $\dddot{Fe}\,\dddot{S}^5$ and $\dddot{Fe}^2\,\dddot{S}$. The phenomenon naturally depends no less on the forces which cause the elements to combine, than on the change of form produced upon the new molecules created by the addition of oxygen; and so long as we remain ignorant of the greater part of what concerns these two circumstances, we shall be obliged to content ourselves with simply knowing the facts. It is alike blamable not to speculate at all about the causes of phenomena, and to push the speculation to a length, where, no longer being guided by experiment, it becomes altogether fictitious and imaginary.

At the side of this corpuscular theory, M. Berzelius has placed another, that of volumes. As experiment proves that almost all bodies are capable of being volatilized in temperatures sufficiently elevated, it is allowable to conceive all bodies as existing under the gaseous form, in which they must of course obey the laws, discovered by M. Gay Lussac, concerning the volumes of gases in a state of combination. Regarding water as compounded of two molecules of hydrogen to one of oxygen, it follows that the weight of a volume of an elementary substance is equal to the weight of a molecule of the same substance. And hence the only difference between these two hypotheses lies in the circumstance, that the one views bodies in the solid, the other in the gaseous state. The latter is founded entirely on facts; it is therefore less hypothetical than that of molecules, and serves better to direct our researches concerning chemical proportions. But, after all, when one attempts to form an idea of what a gas is, and of the state in which the solid particles, gasified by heat, really exist in such a substance, the speculation always reverts to molecules, and shows that both hypotheses are substantially the same, their difference consisting solely in the words atom and volume.

What has now been laid down with regard to the state of combination among molecules, is applicable only to inorganic nature. The case is widely different in the kingdoms of organic nature, where the great series of analogous bodies display modes of combination much more numerous, we might almost say, innumerable. In proof of this, we have only to consider the long list of essential oils, for example, in which the difference of specific gravity, smell, &c. prove that they cannot have the same composition; whilst, on the other hand, their general chemical characters prove that the difference in their composition must be very inconsiderable. How can this be reconciled with what we have just stated concerning inorganic nature?

M. Berzelius extended his experiments also to this very difficult and delicate point; to see if it were possible to find the general differences among the laws, according to which these two different departments of nature have been formed. He analyzed the following vegetable substances: oxalic, acetic, succinic, formic, tartaric, citric, saccolactic, benzoic, and gallic acids; tannin, sugar, sugar of milk, gum, and starch. Although this is not the place for giving an account of the analytic method employed in those experiments, it may not be altogether useless to devote a few words to that point. He combined the substance to be analyzed with oxide of lead, and deprived this combination of all its water, and afterwards analyzed it to discover the exact quantity of oxide of lead and of vegetable matter contained in it. A quantity of this substance, correctly weighed, was then burnt with superoxygenated muriate and oxymuriate of potass, in an apparatus contrived for the purpose. The water and carbonic acid extracted from it, indicated the quantity of hydrogen and carbon. The loss was the oxygen of the substance. On analyzing the fourteen substances above mentioned, he always found the oxygen of the substance to be an integer multiple of that contained by the oxide of lead, with which it had been combined; so that organic substances appear to obey the same law as inorganic oxides. Now, according to the reasons already explained, the number by which the oxygen of the analyzed substance is a multiple of the oxygen contained in the oxide of lead combined with it, must either be the number of molecules of oxygen in the analyzed substance, or else it must be an integer divisor of the number of those molecules. But, if it is allowable to conceive substances as compounded of atoms or molecules, the resulting weights of hydrogen and of carbon must also be those of some number of entire molecules belonging to these two elements. Acetic acid, for example, is composed of 46.934 parts of oxygen, 46.871 parts of carbon, and 6.195 parts of hydrogen. The quantity of oxide of lead neutralized by this quantity of acetic acid, contains 15.645 parts of oxygen, and $15.645 \times 3 = 46.934$; but, if this quantity of oxygen forms 3 molecules, 46.871 will form 4 molecules of carbon, and 6.195 will form 6 of hydrogen. So that each molecule of acetic acid is composed of $6\,H + 4\,C + 3\,O$. The following is a summary of the analytical results obtained by M. Berzelius from analyzing the fourteen substances in question.

Names of the Substances.	*Capacity of Saturation.	Number of Atoms.			Results in per Cents.		
		O.	C.	H.	Oxygen.	Carbon.	Hydrogen.
Oxalic Acid	22.13	18	12	1	66.534	33.222	0.244
Formic Acid	21.58	3	2	2	64.76	32.40	2.84
Succinic Acid	15.97	3	4	4	47.923	47.859	4.218
Acetic Acid	15.64	3	4	6	46.934	46.871	6.195
Citric Acid	13.58	4	4	4	55.096	41.270	3.634
Gallic Acid	12.67	3	6	6	38.023	56.928	5.019
Tartaric Acid	11.98	5	4	5	59.882	36.167	3.951
Benzoic Acid	6.7	3	15	12	20.43	74.41	5.16
Cane Sugar	9.8	10	12	21	49.083	44.115	6.802
Sugar of Milk	12.3	4	5	8	48.348	45.267	6.385
Saccolactic Acid	7.6	8	6	10	60.818	34.164	5.018
Potato Starch	8.34	6	7	13	49.583	43.327	7.090
Tannin of Galls	3.75	12	18	18	45.00	50.55	4.45
Gum Arabic	4.3	12	18	24	51.456	41.752	6.792

If an organic substance cannot be combined with an oxide of composition, it is impossible to find, with any certainty, what number of molecules it contains; because a very small difference in the numerical result of the analysis, especially in the quantity of the hydrogen, may produce very great mistakes when the number of atoms contained by each element is attempted to be calculated. To convince ourselves of this, we have only to compare the numbers resulting from the analysis of tartaric acid and of saccolactic acid, or the analysis of starch with that of sugar. In analyzing inorganic substances, two experiments on the same substance frequently differ more widely than the analyses now mentioned.

From his researches, M. Berzelius draws the following conclusions. Inorganic nature differs from organic, in the circumstance that *the former is composed of binary combinations* (combinations of two elements) *existing alone, or combined among themselves.* Every inorganic substance, whatever be the number of its elements, is capable of being decomposed into binary combinations, and of being recomposed from them; *so that in all inorganic substances, the compound bodies of the first order*, that is to say, bodies compounded immediately of elements, *contain but two of those elements.* What still farther characterizes inorganic composition, is, that on seeking the number of molecules contained in each compound particle, whatever be the number of elements, one of them is found to appear there only *by a single molecule;* except in some saline combinations, where two molecules of one of the combustible radicals are in a few cases combined with three of the other.

In organic nature, compound bodies of the first order, or bodies composed immediately of elements, contain always more than two, and oxygen is constantly, without exception, one of them. None of those elements is of necessity single; and their combinations appear to be capable of taking place, according to an almost infinite number of proportions; from which results a boundless variety of organic substances composed of 3 and 4 elements. Upon this principle we can understand how nature, without violating the laws of chemical proportions, may produce several different species of sugars, of gums, starch, resins, and so forth; because the particle of cane-sugar, for example, being composed of $10\,O + 12\,Ca + 21\,H$, by adding or subtracting a molecule of any one of its elements, there would result a different body, the elements and composition of which are, however, too little altered to make it cease from being sugar, though of another species.

As to ammonia, the composition of which is not to be found in any of the tables given above, Berzelius considers it as a production of organic nature, formed according to the same principle as other such productions; that is to say, of oxygen combined with two combustible radicals, hydrogen and the supposed radical of azote. The combination consists in the present case of one molecule of oxygen, one of the radical of azote, and six of hydrogen. Other chemists consider it as compounded of three molecules of hydrogen, and one of azote.

Some time previous to the labours of Berzelius, MM. Gay Lussac and Thenard had analyzed several animal and vegetable substances by burning them with superoxygenated muriate of potass. Many of their results coincide pretty nearly with those of Berzelius; others differ from them. Determinate proportions had not then become an object of attention to chemists; and consequently MM. Gay Lussac and Thenard have but slightly considered them. They regard vegetable substances as composed of water and carbon, whenever hydrogen and oxygen appear in the proportions forming water. They regard animal substances as composed of water, ammonia, and carbon, having sometimes one element in excess, sometimes another. This idea, however, in their use of it, amounts to nothing more than a mode of exhibiting those proportions which subsist among the elements. After the work of Gay Lussac and Thenard, M. de Saussure engaged in the analysis of alcohol and ether. He performed his experiments with great care. Following the method of the chemists just mentioned, he considers alcohol as compounded of two parts by weight of olefiant gas, with one part of water, both reduced to their elements; and ether, as compounded of four parts by weight of olefiant gas, and one of water. Though it cannot be affirmed that M. de Saussure has deceived himself in assigning these proportions, it is nevertheless clear that his mode of considering organic composition renders it absolutely analogous to that of inorganic substances. Under this point of view, it is impossible to understand those innumerable variations which occur in bodies of a similar nature; because if those combinations of carbon and olefiant gas with water took place according to the laws of chemical proportions, as they are obeyed by all binary combinations, the actual multiplicity of organic combinations could not possibly exist, and the whole would remain confined within the narrow limits prescribed to inorganic nature.

After this historical exposition of the leading facts relative to chemical proportions, with the various modes employed to explain them, and elicit their general laws, some observations will be necessary with regard to the speculative part of the subject. We shall conclude by detailing the opinions entertained upon this subject by the most illustrious chemists of our age.

The state of philosophy, it is clear, produces a considerable influence on the degree of interest excited by each fresh step in the sciences; and frequently the colour assumed by a new discovery depends altogether on this circumstance. In former ages, the ideas enter-

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* By capacity of saturation is understood the quantity of oxygen found in that portion of a base, by which a hundred parts of the particular substance are neutralized.

Proportions, Determinate.

tained concerning the interior constitution of bodies were coarse, as well as quite imaginary. A more refined spirit of philosophy rejected and turned them into ridicule. Kant, the far-famed philosopher of Konigsberg, founded a system altogether new, maintaining that the existence of all things depends on two opposite forces, the one of which, acting by itself, would concentrate all the matter of the universe into a mathematical point; whilst the other, on a similar supposition, would diffuse it to an infinite extent. The struggle of these two forces constitutes matter, the diversities of which result from the different proportions of those two opposite powers. This system has been named that of Dualism, or the Dualistic system. Whilst admiring the sagacity with which the author has developed his system, rendered still more striking by the posterior electro-chemical discoveries, which are almost foreseen by it; one cannot avoid astonishment at this entire annihilation of matter. The genius of Kant soon awakened a crowd of philosophic minds, possessing more or less elevation, who continued to philosophise on the subjects connected with chemistry and physics, and erected what they called a Philosophy of Nature, (*Natur-Philosophie* in German.) Nearly all these philosophers were destitute of knowledge in the sciences, which by *à priori* speculations they undertook to reform; they endeavoured to supply the want of real information by systems of anticipations. At the time when a philosophy resembling in some respects a contagious malady of the soul, had thus infected a multitude of understandings, particularly in Germany, Mr. Dalton appeared with his atoms; but, in contrast with Kant, neglecting to adopt in his system the forces on which those combinations depend, and considering nothing but matter alone. Whilst in the system of Kant every thing is impenetrable, every thing, with Dalton, is mere juxta-position among certain figures which he attempts to trace. At first, therefore, no attention was paid to this latter system; but Dr. Thomson, an English chemist, of high celebrity as an author, by publishing the opinions of Dalton in his writings, and showing what might be their real value, contributed greatly to produce a favourable impression on the public. And thus, notwithstanding the sneers of a pretended spirit of philosophy, though stigmatized as rude, because they rendered things palpable, so to speak, yet here and there atomic ideas and the corpuscular theory took root, and the labours we have just surveyed were the result.

Dr. Thomson adopted the atomic ideas of Mr. Dalton; he has applied them to the chemical system; and given, in the journal which he edits, a statement of the weight of the molecules, in several substances, simple as well as compound. Like Berzelius and Wollaston, he disagrees with Dalton in putting the weight of oxygen = 1.000.*

		Weight of an Atom.
1	Oxygen	1·000
2	Chlorine	4·500
3	Iodine	15·625
4	Hydrogen	0·125
5	Carbon	0·750
6	Boron	0·875
7	Silicon	1·000
8	Phosphorus	1·500
9	Azote	1·750
10	Sulphur	2·000
11	Tellurium	4·000
12	Arsenic	4·750
13	Potassium	5·000
14	Sodium	3·000
15	Calcium	2·625
16	Barium	8·750
17	Strontium	5·500
18	Magnesium	1·500
19	Potash	6·000
20	Soda	4·000
21	Lime	3·625
22	Barytes	9·750
23	Strontian	6·500
24	Magnesia	2·500
25	Yttrium	4·000
26	Yttria	5·000
27	Glucinum	2·250
28	Glucina	3·250
29	Aluminum	1·125
30	Alumina	2·125
31	Zirconium	4·625 ?
32	Zirconia	5·625 ?
33	Iron	3·500
34	Protoxide of iron	4·500
35	Peroxide of iron	10·000
36	Nickel	3·375
37	Protoxide of nickel	4·365
38	Peroxide of nickel	9·750
39	Cobalt	3·625
40	Protoxide of cobalt	4·625
41	Peroxide of cobalt	10·250
42	Manganese	3·500
43	Protoxide of manganese	4·500
44	Peroxide of manganese	5·500
45	Uranium	15·625
46	Protoxide of uranium	16·625
47	Peroxide of uranium	34·250
48	Cerium	5·750
49	Protoxide of cerium	6·750
50	Peroxide of cerium	14·500
51	Zinc	4·125
52	Oxide of zinc	5·125
53	Lead	13·000
54	Protoxide of lead	14·000
55	Peroxide of lead	15·000
56	Tin	7·375
57	Protoxide of tin	8·375
58	Peroxide of tin	9·375
59	Copper	8·000
60	Protoxide of copper	9·000
61	Peroxide of copper	10·000
62	Bismuth	8·875
63	Oxide of bismuth	9·875
64	Mercury	25·000
65	Protoxide of mercury	26·000
66	Peroxide of mercury	27·000
67	Silver	13·750
68	Oxide of silver	14·750
69	Gold	24·875
70	Protoxide of gold	25·875
71	Peroxide of gold	27·875

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* In place of inserting here the Tables published by Dr. Thomson, in the *Annals of Philosophy*, vol. ii. iii. iv. and v. we have given the more correct ones which he published in 1818, in the xiith volume of that work.—Ed.

Proportions, Determinate.

	Weight of an Atom.
72 Platinum	22·625
73 Protoxide of platinum	23·625
74 Peroxide of platinum	25·625
75 Palladium	7·000
76 Oxide of palladium	8.000
77 Rhodium	15·000
78 Protoxide of rhodium	16·008
79 Deutoxide of rhodium	17·000
80 Peroxide of rhodium	18.000
81 Iridium	6·000
82 Antimony	5·625
83 Protoxide of antimony	6·625 ?
84 Deutoxide of antimony	20·875
85 Peroxide of antimony	7·625
86 Chromium	3·500
87 Chromic acid	6·500
88 Molybdenum	6·000
89 Protoxide of molybdenum	7·000
90 Deutoxide of molybdenum	8·000
91 Molybdic acid	9·000
92 Tungsten	12·000
93 Protoxide of Tungsten	14·000
94 Peroxide of Tungsten	15·000
95 Columbium	18·000
96 Oxide of Columbium	19·000
97 Titanium	18·000?
98 Protoxide of titanium	19·000?
99 Deutoxide of titanium	20·000?
100 Peroxide of titanium	21·000?
101 Ammonia	2·125

	Number of Atoms.	Weight of a Particle.
102 Water composed of	1 *o* + 1 *h*	1·125
103 Carbonic oxide	1 *c* + 1 *o*	1·750
104 Carbonic acid	1 *c* + 2 *a*	2·750
105 Chlorocarbonic oxide	1 *c* + 1 *o* + 1 *ch*	6·250
106 Çyanogen	2 *c* + 1 *a*	3.250
107 Olefiant gas	1 *c* + 1 *h*	0·875
108 Carburetted hydrogen	1 *c* + 2 *h*	1·000
109 Chloric ether	2 *c* + 2 *h* + 1 *ch*	6·250
110 Hydrocarbonic oxide	3 *c* + 3 *o* + 1 *h*	5·375
111 Boracic oxide	1 *b* + 2 *o*	2·875
112 Silicia	1 *s* + 1 *o*	2·000
113 Hypophosphorous acid	1 *p* + 1 *o*	2·500
114 Phosphorous acid	1 *p* + 2 *o*	3.500
115 Phosphoric acid	1 *p* + 3 *o*	4·500
116 Protophosphuretted hydrogen	1 *p* + 2 *h*	1·750
117 Perphosphuretted hydrogen	1 *p* + 1 *h*	1·625
118 Protochloride of phosphorus	1 *p* + 1 *ch*	6·000
119 Perchloride of phosphorus	1 *p* + 2 *ch*	10·500
120 Phosphuret of carbon	1 *p* + 1 *c*	2·250
121 Hyposulphurous acid	1 *s* + 1 *o*	3·000
122 Sulphurous acid	1 *s* + 2 *o*	4·000
123 Sulphuric acid	1 *s* + 3 *o*	5·000
124 Chloride of sulphur	1 *s* + 1 *ch*	6·500
125 Sulphuretted hydrogen	1 *s* + 1 *h*	2·125
126 Sulphuret of carbon	2 *s* + 1 *c*	4.750
127 Sulphuret of phosphorus	1 *s* + 1 *p*?	3·500 ?
128 Arsenious acid	1 *a* + 1·5 *o*	6·250
129 Arsenic acid	1 *a* + 2·5 *o*	17·250
130 Chloride of arsenic	1 *a* + 1·5 *ch*	11·500

	Number of Atoms.
131 Sulphuret of arsenic	1 *a* + 2 *s* ?
132 Oxide of tellurium	1 *t* + 1 *o*
133 Telluretted hydrogen	1 *t* + 1 *h* ?
134 Protoxide of azote	1 *a* + 1 *o*
135 Deutoxide of azote	1 *a* + 2 *o*
136 Hyponitrous acid	1 *a* + 3 *o*
137 Nitrous acid	1 *a* + 4 *o*
138 Nitric acid	1 *a* + 5 *o*
139 Chloride of azote	1 *a* + 4 *ch*
140 Sulphuret of potassium	1 *p* + 1 *s*
141 Sulphuret of sodium	1 *so* + 1 *s*
142 Protosulpuret of iron	1 *i* + 1 *s*
143 Persulphuret of iron	1 *i* + 2 *s*
144 Sulphuret of cobalt	1 *c* + 1 *s*
145 Sulphuret of zinc	1 *z* + 1 *s*
146 Protosulphuret of bismuth	1 *b* + 1 *s*
147 Persulphuret of bismuth	1 *b* + 2 *s*
148 Protosulphuret of lead	1 *l* + 1 *s*
149 Persulphuret of lead	1 *l* + 2 *s*
150 Protosulphuret of tin	1 *t* + 1 *s*
151 Persulphuret of tin	1 *t* + 2 *s*
152 Sulphuret of copper	1 *c* + 1 *s*
153 Protosulphuret of mercury	1 *m* + 1 *s*
154 Persulphuret of mercury	1 *m* + 2 *s*
155 Sulphuret of silver	1 *si* + 1 *s*
156 Sulphuret of gold	1 *g* + 1 *s*
157 Sulphuret of palladium	1 *p* + 1 *s*
158 Oxalic acid	0 *h* + 2 *c* + 3 *o*
159 Formic acid	1 *h* + 2 *c* + 3 *o*
160 Mellitic acid	1 *h* + 4 *c* + 3 *o*
161 Succinic acid	2 *h* + 4 *o* + 3 *o*
162 Acetic acid	3 *h* + 4 *c* + 3 *o*
163 Citric acid	3 *h* + 4 *c* + 4 *o*
164 Tartaric acid	3 *h* + 4 *c* + 5 *o*
165 Gallic acid	3 *h* + 6 *c* + 3 *o*
166 Tannin	3 *h* + 6 *c* + 4 *o*
167 Saclactic acid	5 *h* + 6 *c* + 8 *o*
168 Benzoic acid	6 *h* + 15 *c* + 3 *o*
169 Muriatic acid	1 *h* + 1 *ch*
170 Chloric acid	1 *ch* + 5 *o*
171 Protoxide of chlorine	1 *ch* + 1 *o*
172 Deutoxide of chlorine	1 *ch* + 2 *o*
173 Hydriodic acid	1 *h* + 1 *i*
174 Iodic acid	1 *i* + 5 *o*
175 Chloriodic acid	1 *i* + 2 *ch* ?
176 Hydrocyanic acid	1 *cy* + 1 *h*
177 Alcohol	2 olefiant gas + 1 water
178 Sulphuric ether	4 olefiant gas + 1 water ?
179 Nitric ether	4 olefiant gas + 1 nitric acid ?
180 Chloric ether	2 olefiant gas + 1 chlorine
181 Muriatic ether	4 olefiant gas + 1 muriatic acid ?
182 Hydriodic ether	4 olefiant gas + 1 hydriodic acid ?
183 Acetic ether	4 olefiant gas + 1 acetic acid ?
184 Formic ether	4 olefiant gas + 1 formic acid ?
185 Olive oil	11 *h* + 10 *c* + 1 *o*
186 Bees-wax	18 *h* + 20 *c* + 1 *o*
187 Rosin	13 *h* + 15 *c* + 2 *o*
188 Copal	18 *h* + 19 *c* + 2 *o*
189 Woody fibre	4 *h* + 7 *c* + 4 *o*
190 Starch sugar	5 *h* + 5 *c* + 5 *o*
191 Common sugar	5 *h* + 6 *c* + 5 *o*
192 Gum arabic	6 *h* + 6 *c* + 6 *o*
193 Starch	10 *h* + 10 *c* + 9 *o*
194 Gelatin	14 *h* + 15 *c* + 6 *o* + 2 *a*
195 Albumen	13 *h* + 17 *c* + 6 *o* + 2 *a*
196 Fibrin	14 *h* + 18 *c* + 5 *o* + 3 *a*

Proportions, Determinate.

Sulphates.

	Atoms of acid, base, and water.		Weight of a Particle.
lphate of ammonia	1 *s* + 1 *a* +	3 water	1.700
lphate of potash .	1 *s* + 1 *p* .	.	11·000
sulphate of potash	2 *s* + 1 *p* .	.	16·000
lphate of soda .	1 *s* + 1 *s* +	10 water	9·000
ydrous sulphate of lime	1 *s* + 1 *l* +	2 water	8·625
nhydrous sulphate of lime	1 *s* + 1 *l* .	.	
lphate of barytes	1 *s* + 1 *b* .	.	14·750
sulphate of barytes	2 *s* + 1 *b* .	.	19·750
lphate of strontian	1 *s* + 1 *str*	.	11·500
lphate of magnesia .	1 *s* + 1 *m* +	5 water	7·500
lphate of glucina	1 *s* + 1 *gl* .	.	8·250
sulphate of glucina	2 *s* + 1 *gl* .	.	13·250
bsesquisulphate of glucina . .	2 *s* + 3 *gh* .	.	19·750
lphate of Alumina	1 *s* + 1 *a* .	.	7·125
lphate of iron . .	1 *s* + 1 *i* +	7 water	9·500
rsulphate of iron .	1 *s* + 1 *i* .	.	15·000
ripersulphate of iron	3 *s* + 1 *i* .	.	25·000
b-bipersulphate of iron	1 *s* + 2 *i* .	.	25·000
lphate of nickel .	1 *s* + 1 *n* +	7 water	9·375
lphate of cobalt .	1 *s* + 1 *c* +	7 water	9·625
lphate of manganese	1 *s* + 1 *m* +	5 water	9·500
lphate of zinc .	1 *s* + 1 *z* +	5 water	10·125
lphate of lead .	1 *s* + 1 *l* .	.	19·000
sulphate of copper	2 *s* + 1 *c* +	10 water	20·080
bsulphate of copper	2 *s* + 3 *c* +	6 water	40·000
lphate of bismuth	1 *s* + 1 *b* .	.	14·875
bsulphate of bismuth	1 *s* + 3 *b* .	.	34·625
lphate of mercury	1 *s* + 1 *m* .	.	31·000
urpeth mineral, or persulphate of mercury	1 *s* + 1 *m* .	.	32·000
ipersulphate of mercury	1 *s* + 1 *m* .	.	37·000
lphate of silver .	1 *s* + 1 *si* .	.	19.750
lphate of platinum	1 *s* + 1 *pl* .	.	28·625

Since Dr. Thomson regards water as composed of an atom of oxygen and one of hydrogen, it follows that in most substances, the weight he assigns to the atom, is twice the weight of the volume in a gaseous form, compared with the weight of the volume of oxygen in a gaseous form.

Dr. Wollaston, without expressly declaring himself a partisan or an opponent of the corpuscular hypothesis, looks upon what others have named atoms, or molecules, as relative weights, in which experience has shown that bodies most readily combine. He calls them *chemical equivalents*. Oxygen with him, is = 1·000; and water is composed of an equivalent of oxygen, and one of hydrogen. Wollaston's numbers differ a little from those of Thomson. The equivalents being to each other in fixed proportions, their mutual combinations may be calculated by the Rule of Three. And upon this principle, Dr. Wollaston has invented a very ingenious instrument to facilitate the calculation. It is well known that Gunter's scale, employed in sliding-rules, is divided in such a manner, that the numbers 1, 2, 3, 4, &c. are arranged upon it so as to have their distances proportional to their logarithms. On a similar sliding-rule, covered with card, Dr. Wollaston marks his numbers on the slider; but upon the two sides, in place of writing the numbers, he writes the names of the substances equivalent to them. Thus, whoever knows how to use the sliding-rule, knows also how to use this instrument. Suppose, for example, any one wishes to decompose muriate of soda, and to know how much of the decomposing substances is required. He must draw the slider till 100 (or such other number as he may choose) corresponds to muriate of soda. Now, the names soda and muriatic acid, correspond to the number of parts of soda and of acid contained in 100 parts of the muriate. Opposite to the name sulphuric acid, stands the number of parts of this substance necessary to be used for decomposing 100 parts of the muriate of soda; and in like manner, the names nitrate of silver, sulphate of ammonia, &c. &c. are found opposite to the numbers indicating how many parts of them are necessary to be used in the same operation. The instrument we have just described, is a fine monument of its author's genius. Its utility is great; and Dr. Wollaston has so judiciously chosen the bodies marked on it, that the greater part of those commonly employed in laboratories, are to be found in his list. Yet the scale admits no great extension; because there is not room for many names, of which, moreover, several must correspond to the same numbers; and as the space gets filled with names, it will become more difficult to find the particular one we are in quest of. Besides, when there happen to be two or more equivalents of the same substance in a compound body, unless the number of them is known before hand, it will be difficult to discover the composition. Suppose we wish to find the composition of the sulphate of red oxide of iron. Taking 100 parts, the weight of its equivalent would be found = 129·5. The slider is drawn till 100 corresponds to the number of the sulphate; the name sulphuric acid then corresponds to 38·7, but in reality it contains 38·7 × 1½ = 58; so that, to avoid being misled by the instrument, we ought to know that this salt contains the equivalent and half not only of sulphur, but also of sulphuric acid, and of oxygen in the oxide. It is on this account, that Dr. Wollaston has omitted most part of such combinations. For some salts, containing water of crystallization, he has added to the name of the salt, the number of equivalents of water included in it, so that they are indicated by the instrument.

To profit more extensively by this mode of calculation, M. Berzelius has formed an alphabetical list of all the substances whose composition is known, and annexed to it the formulæ expressing the number of atoms contained in each substance, and the number expressing its weight, that of oxygen being supposed = 1·000. By means of these tables, and a common sliding-rule, such as may be found in the shop of any instrument-maker, all manner of compositions may be calculated. This plan has the advantage over that of Wollaston, in so far as its utility is more general, all known substances being comprehended in it; but the latter is more agreeable, as it presents all the equivalents at a single glance.

Sir H. Davy, in his paper, "On some of the Combinations of oxymuriatic gas and oxygen," &c. *Phil. Trans.* 1811, observes, in speaking of Mr. Dalton's opinions: "I shall enter no further at present into an examination of the opinions, results, * * * Inflammable bodies, acids, alkalis, &c. must separate in uniform ratios." Sir Humphry appears then, whilst he admits that Dalton's results are deducible from his hypothesis, not to approve of the corpuscular theory in itself, regarding it as too hypothetical. In volume

Proportions, Determinate.

first, part first, of his "Elements of Chemical Philosophy," Sir H. adopts the system of chemical proportion, for most part as Mr. Dalton does; but he gives the name of *proportion* to what Dalton calls an *atom*, and Wollaston an *equivalent*.

In Germany, M. Gilbert has carefully collected, in the Journal conducted by him, under the title of *Annalen der Physik*, whatever has a reference to the subject of chemical proportions. A statement of the doctrine was given so early as the number for Dec. 1811. M. Schweigger, too, in his *Journal für Chemie und Physik*, has in like manner adopted the system of chemical proportions, without, however, approving of the atomic theory, perhaps because it is too repugnant to the ideas entertained by the school, of which he seems to be a follower.

Among French chemists, Messrs. Gay Lussac and Thenard appear, by their latest writings, to have likewise begun to adopt the system of chemical proportions, though they have as yet published nothing specially on the subject.

Thus it would seem that the doctrine of determinate proportions in chemistry may be regarded as a settled truth, generally acknowledged among men of science, although the corpuscular theory, or the hypothesis concerning the cause of these proportions, is adhered to by a smaller number.

PROPORTIONAL COMPASSES. See DRAWING INSTRUMENTS, Vol. VIII. p. 125.

PROSODY, from προσῳδια, is a name given to the doctrine of the proper accent of syllables; and comprehends the rules for determining the quantity of the syllables which compose the ancient languages.

PROTRACTOR. See DRAWING INSTRUMENTS, Vol. VIII. p. 121; and Dr. Brewster's *Treatise on New Philosophical Instruments*, p. 129.

PROVIDENCE. See RHODE ISLAND.

PRUSSIA.

Prussia.

PRUSSIA, formerly a duchy, but now a powerful and extensive kingdom in Europe, is thought by some to have derived its name from its vicinity to the vast country of Russia. The Sclavonic word *po* signifying near or adjacent, the district which Prussia originally comprehended was in reference to Russia, as is supposed, denominated Po-Russia, a term afterwards softened into Prussia. Nor is this derivation of names entirely fanciful or unprecedented. The river Elbe, in the Sclavonic speech, was termed Labe; and hence, on the principle referred to above, the tribes which inhabited its banks were called Po-Labae, or Polabae. The word Prussia, however, whatever probability there may be in the foregoing etymology, has been traced by others to a different source, and has been supposed to be obtained from the Prusi or Pruzi, a Sclavonic people, whom ancient chroniclers mention as inhabiting a portion of the country which we are now considering. In which of these conjectures the greater confidence may be placed, it is now too late to determine: but it may not be uninteresting to state, that the former, namely, the derivation of the word from Po and Russia, has obtained the sanction of a late illustrious king of Prussia, (Frederick the Great,) in his *Memoirs of the House of Brandenburg*.

Extent and Divisions.

The extent of Prussia has been different at various periods. Its size is now greater than at any former date; and while under this and the succeeding heads, we give an account of it according to its present circumstances, we shall, when treating of its history, investigate its gradual accumulation of territory, until from a petty duchy it has become one of the first powers in Europe. Its figure is extremely disjointed, and indeed has long been so, being from a very remote period composed of small and distinct states, without any regard to compactness or regularity of form. The remark of Voltaire, that the Prussian dominions stretched along the map of Europe like a pair of garters, is, if possible, more applicable at the present moment than a century ago when it was made. Its breadth from north to south varies from 70 to 350 miles, its greatest breadth being between the Baltic at Dantzick and the south of Silesia; its length is not less than 12,00 miles, stretching in a line from south-west to north-east, or from the borders of France to the river Memel, which divides it from Russia. It lies between 50° and 55° of north lat. and between 6° 30′ and 24° of east longitude. The length, however, given above, is not continuous; and between the eastern and western provinces there is no direct intercourse without the intervention of other states. Thus, Hanover on the north stretches a considerable way into the Prussian dominions; and towards the south, the states of Brunswick, Hesse-Cassel, Waldeck, Darmstadt, Nassau, and others, intercept the direct communication. Prussia is, besides, possessed of other territories, detached from those which the foregoing measurement embraces, and forming insulated spots in the centre of the dominions of other powers,—such as Neufchatel, one of the Swiss cantons, as well as small detached portions in Saxony, Saxe Weimar, &c. And Prussia formerly included Anspach in Franconia, which in 1806 was given by Bonaparte to Bavaria, and has been confirmed to that power by subsequent treaties. The whole dominions of Prussia were, after the peace of 1814, divided and subdivided according to the following Table:

Provinces.	Sq. Miles.	Governments.
East Prussia, formerly Ducal Prussia,	15,115	Konigsburg. Gumbinne.
West Prussia, or Polish Prussia,	10,000	Dantzick. Marienwerder.
Posen, formerly part of Poland, and including part of the late duchy of Warsaw,	11,251	Posen. Bromburg.
Saxony, obtained from the centre of the kingdom of Saxony in 1815,	8,492	Merseburg. Magdeburg. Erfurt.
Brandenburg,	14,939	Berlin. Potsdam. Frankfort on the Oder.
Silesia,	14,864	Breslau. Reichenbach. Leignitz. Oppeln.

Provinces.	Sq. Miles.	Governments.
Pomerania,*	12,363	Stettin. Coslin. Stralsund.
Westphalia,	7,565	Munster. Munden. Arensburg.
Juliers, Cleves and Berg, formerly belonging partly to Westphalia, and partly to the Lower Rhine,	3,638	Dusseldorf. Cleves. Cologne.
Lower Rhine,	6,432	Aix-la-Chapelle. Coblentz. Treves.
Total number of sq. miles,	104,656	

From this enumeration, there are, it is evident, ten provinces, exclusive of Neufchatel, which acknowledges the sovereignty of Prussia, but retains its own laws and usages, and which amounts to 50,000 inhabitants. Each of these provinces, it is also apparent, is subdivided into two or more governments, making twenty-eight in all;—and the governments contain severally eight, ten, or twelve districts, or even more, termed circles. The object of these subdivisions is the prompt and correct administration of justice. Minute as these divisions may appear, there are yet other divisions of a different kind, namely, for military purposes; a department which the successive Prussian monarchs have cultivated with great ardour and success. These are five in number, Prussia; Brandenburg and Pomerania; Silesia and Prussian Poland; Saxony; Westphalia and the Lower Rhine.

ion. The population of the Prussian dominions, though it varies in density in the several divisions, has been ascertained with considerable minuteness. The following is the result of the last census arranged according to the amount of each province:

Provinces.	Population.
Silesia,	1,992,598
Brandenburg,	1,297,795
Saxony,	1,214,219
Westphalia,	1,074,079
Lower Rhine,	972,724
Juliers, Cleves and Berg,	935,040
East Prussia,	919,580
Posen,	847,800
Pomerania,	700,766
West Prussia,	581,970
Total population,	10,536,571

From this table it appears that, in proportion to their extent, Juliers, Cleves and Berg, the Lower Rhone, and Silesia are the most populous; and East Prussia, West Prussia, Pomerania, and Posen, are the least so. We found above, that the whole Prussian territories embrace an area of 104,656 square miles, and from the calculations last stated, the number of inhabitants amounts to 10,536,571, averaging about 99 to a square mile. But so widely different is the ratio of population in the different provinces, that while Juliers, Cleves and Berg, contain 255 to each square mile, East Prussia does not exceed 58, and some of the other provinces, as specified above, are not much above that number. Of this population, the males are 5,244,308, and the females, 5,292,623. In 1740, Prussia, though then possessed of part of Silesia, and of extensive territories in the north of Germany, contained only 3,000,000; but since that time, partly by acquisition, and partly by an augmentation of numbers in the old states, she has considerably more than tripled her population. She is now, in this respect, superior to Poland and European Prussia, inferior by a third to France, and by a half to England and Ireland.

Prussia.

Physical appearance.

The physical appearance of territories so extensive is less varied and striking than one could easily conjecture. In Pomerania, so slight is the slope towards the sea, that the land would be inundated to a great extent by the tide, were it not protected by a long range of sand hills or artificial dikes. The rivers, both in Pomerania and the other provinces, often inundate the neighbouring country in consequence of the levelness of the surface, or expand into lakes, some of which are of considerable dimensions. A level surface is the general predominating character, and though there may be occasionally some diminutive eminences, there is nothing in the whole of Prussia that can, properly speaking, be denominated a mountain. There are, however, various mountain ridges connected with it, such as the Harts in Saxony, the Riesengebirge, and other large mountains in Silesia, the Westerwald in Westphalia, and the Hundsruck in the Lower Rhine; but these, as they merely form the outskirts or the boundaries of the kingdom, may be regarded as belonging as much to other states as to Prussia. But though Prussia is devoid of mountains, there is a variety in other respects that deserves not to be overlooked. In every quarter of the kingdom, particularly in the eastern parts of it, lakes of every degree of magnitude are more common than in any other country on the continent. The woods and forests, the latter of which, from the remotest date, seem to have distinguished this portion of Europe, are calculated to cover above seventeen millions of acres. Brandenburg, Westphalia, and other places, abound in large plains of sand, or are covered with heath. Silesia, though extremely fertile, is marked more than any other province by gentle inequalities; and the whole Prussian territories are beautifully diversified by the great number of canals, and of large rivers that intersect them in all directions.

Rivers.

Prussia possesses one advantage peculiar to herself, with the exception of Holland and probably of England; namely, her internal communication by water, and her ready communication with the sea by means of large navigable rivers. The shores of the Baltic also are, more than those of any other sea, indented with large and capacious bays, extremely accessible, and favourable to all the purposes of commerce for places in the vicinity. And the more remote parts of the kingdom have a direct communication with the sea by means of majestic rivers, which are not only numerous, but situated at so regular a distance from each other as to answer almost in an equal degree every district of the country. Of these rivers, the Elbe (the *Albis* of the ancients, and the *Labbe* of the Bohemians) deserves first to be mentioned. It rises in the Giant Mountains,

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* Pomerania was formerly possessed partly by Sweden and partly by Prussia. In 1814, Sweden having obtained Norway, ceded Pomerania, with the Island of Rugen to Denmark, in lieu of that country which she had lost. But the King of Denmark, finding that Pomerania lay at too great a distance from his other dominions, bartered it with Prussia for the duchy of Lauenburg, in Lower Saxony, and a certain sum of money.

(Riesengebirge,) between Bohemia and Silesia, passes through Bohemia, and washing Dresden, Wittenburg, and Magdeburg, falls into the German Ocean below Hamburg, not far from Heligoland. It receives the waters of several tributary rivers, the Moldau in Bohemia, the Eger from Franconia, the Milde, the Saale, the Havel, and the Spree, after it has entered the Prussian territories. From Magdeburg it forms only one stream. It is navigable for small vessels as far as Leutmeritz in Bohemia, nearly a hundred miles farther than Dresden. Its navigation, however, is much interrupted, and rendered expensive by the numerous tolls and restrictions imposed by the sovereigns of the different territories through which it flows. These duties have been much diminished since the late peace; but notwithstanding them, there is probably no river in Europe that exhibits a more busy and commercial aspect than the Elbe, 500 vessels continually plying on it, chiefly from Hamburg to Magdeburg.—The Oder has its origin in Moravia, and passing by Ratibor, Breslau, Frankfort, and Stettin, flows into the Baltic by three mouths, forming two islands Ucedom and Wollin. It is navigable as far as Ratibor, about 87 miles south-east of Breslau. It receives several secondary rivers, the chief of which is the Wartha, which, by means of a canal, unites the Oder and the Vistula.—The Vistula takes its rise in the Carpathian mountains, and flowing nearly due north washes Cracow, Warsaw, Plock, and Thorn, and discharges itself into the Baltic at Dantzick. It begins to be navigable at Cracow; and, while it intersects Prussia, it forms at the same time the great channel for the conveyance of corn and other products from the interior of Poland.—These are the most important rivers. Those of inferior note, including the tributary streams, are extremely numerous, some of them very large, and all of them navigable in a greater or less degree. The Pregel in East Prussia runs past Konigsburg, where it is 300 feet wide, and empties itself into the Frisch Haff. The Niemen, or Memel, forms the boundary between Prussia and Russia, and flows past Tilsit into the Baltic. The Spree washes Berlin, falls into the Havel, a tributary stream of the Elbe, and by means of canals unites the Elbe and the Oder. The Rhine, the Weser, and the Ems, though connected with Prussia, belong rather to Germany. All the rivers, as well as the shores of the Baltic, produce fish in great abundance and variety.

Canals. Nor, while rivers are numerous and useful, are canals unknown, to connect the different portions of the kingdom with each other, as rivers connect all parts of it with the sea. In the eastern extremity of the kingdom there are two large canals, one that connects the Pregel and Memel rivers, and another which stretches from the Pregel to the Vistula. The canal of Bromburg unites the navigable river Brahe to the Netz, which falls into the Wartha, which last stream, likewise navigable, joins the Oder. And as we have already mentioned that the Oder and Elbe are connected, partly by the Spree and partly by a canal, there is evidently a line of communication by means of canals, running at right angles with the rivers from the eastern almost to the western extremity of Prussia, or a distance of about 800 miles. There are also various other canals of minor importance, but all of them of great local benefit. 600 barges, of thirty tons each, besides smaller boats, continually ply on the Bromburg canal, which serves to unite the Vistula and the Oder; and the canals which connect the Oder and the Elbe exhibit a still more busy and commercial appearance. No country can boast of such advantages; and they are such as, with the industry and energy which characterise the Prussians, cannot fail soon to raise them in point of internal resources to a level with the most opulent nations of Europe.

Prussia, from the level nature of the country, may be expected to contain numerous lakes. This indeed, as stated above, is the fact in an eminent degree, particularly in the eastern provinces, in Pomerania, and in Brandenburg. In East Prussia there are, it is reckoned, 300 lakes, of which the Spelding See is the largest, being twenty British miles in every direction; there are 160 in West Prussia; and no less than 680 in Brandenburg. The name of *Werder*, as Marienwerder, which is of frequent occurrence, particularly in West Prussia, signifies a drained marsh or land surrounded by water; a fact that indicates that lakes were more abundant in former times than at present. Lakes are more or less common in every quarter of the kingdom; and the rivers, from the laziness of their currents, frequently stagnate, and spread their waters so wide, often many miles, that the space thus occupied may with propriety be regarded as a lake. The estuaries of the Oder, Vistula, and Memel, form large maritime sheets of water, termed in German *Haffs*. Thus at the mouth of the Memel is the Curisch Haff; at that of the Vistula Frisch Haff, (with another inland creek called the lake of Drausen,) as that of the Oder is the Grass Haff. This last is thirty-six miles long, and from one to nine in breadth; the Curisch Haff is sixty miles in length, with a mean breadth of ten miles; while the Frisch Haff is seventy miles in length, with a breadth varying from three to ten. There are other Haffs of an inferior size: they are nearly all filled with fresh water as their supplies come from the land, and their connexion with the sea is by a very narrow outlet. None of them is deep; but they are all navigable to vessels of a greater or less size.

The climate of Prussia is not remarkably favourable; for though considerably various in the several provinces, it is in general moist, cold, and ungenial. This is occasioned by the number of marshes, the extent of forests, and the inundations of the rivers and of the sea, of which we have already spoken. Rain is also very common not only during the winter, which in some places lasts about eight months, but even in autumn, sometimes making dreadful devastation. In the eastern districts, and along the shores of the Baltic, cold predominates to a degree unknown in the same latitude of the Netherlands or of England; a circumstance which is accounted for by the reasons already stated, and from the prevalence of easterly winds blowing along the bleak surface of Russia. In the western and middle provinces the climate is uncommonly mild and genial, and not inferior, if not superior, to what we enjoy in Britain. The heat on the sandy plains of Brandenburg is often quite intolerable; and so great a variety is there in the several divisions of the kingdom, that in some parts summer seems to have arrived, when in others the inhabitants are experiencing all the rigour of severe winter. There are no endemic diseases in any quarter of Prussia, and many instances of longevity occur; yet the climate is not remarkable for great salubrity, the deaths averaging 2 in 69, or one male in 33, and one female in 36. In England, it may be remarked, the proportion of deaths between 1810 and

1820 was 1 in 51, and the general proportion is calculated as 1 in 45.

From former observations, some idea must already have been formed of the soil. Though the kingdom is exempted from the bleakness and unproductiveness occasioned by mountains, a great part of it is far from being genial or fertile. This results chiefly from the great tracts of heath and sand which we have already mentioned, and partly from the want of cultivation. Silesia, Posen, the neighbourhood of Tilsit in East Prussia, and the provinces bordering upon the Rhine, (though the first in its northern parts partakes a good deal of the sandy features of Brandenburg,) are the most fertile, as well as the best cultivated,—producing grain of every description, culinary vegetables, fruits, and even grapes in considerable perfection. Both indeed in the provinces just specified, and in other portions of the kingdom, the soil is loamy, deep, and extremely rich, and, if agriculture were cultivated with much assiduity and judgment, is susceptible of the highest improvement. But agriculture, though not entirely neglected, is yet in its infancy. Farming can scarcely be regarded as a distinct profession, as in Britain. Farms are extremely small; the sum applied to agricultural purposes very inconsiderable; and two-thirds of the farmers are at the same time manufacturers, and realize a livelihood as much in the latter capacity as in the former. The system of green-cropping, of fallow, and of rotation of crops, is beginning to be understood, and in some parts of the kingdom is very generally practised. The quantity of land in tillage in 1817 was 29,000,000 acres, exclusive of about 300,000 acres appropriated to garden culture and vineyards. The following is the average increase on the different kinds of grain,—which affords a pretty correct estimate of the quality of the soil, or the degree of cultivation which it undergoes. The average increase of wheat is 6 to 1, of barley 5¾ to 1, of rye 4 to 1, and 4½ to 1 of oats. But though agriculture be a little deficient, Prussia raises more corn than its consumption requires, and in favourable years the value of the surplus exported has amounted to 2,000,000 florins, or £200,000 Sterling. Buck wheat is more extensively grown than any other species of grain. In speaking of the sandy soils of Brandenburg, Marshal observes (and the remark is applicable to other districts,) that "the inhabitants find that the only very profitable crop upon these lands is buck wheat, which they sow in large quantities, and they get a product which equals the best soils applied to that grain. When a piece of land has been more carefully managed than ordinary, it will yield a good crop of rye; but as to wheat or barley it is hardly to be seen." Flax is extensively cultivated, particularly in Westphalia and Silesia, and after supplying the demand of their own domestic manufactures, the growers annually export about 22,000,000 of pounds. Hops, pease, beans, tobacco, are also grown to a considerable extent, and form no inconsiderable articles of export. Wood, which is so abundant in the eastern provinces, is exported, but chiefly that which grows in the vicinity of rivers, as land conveyance is both difficult and expensive. Coffee being a favourite beverage, certain enterprising individuals, thinking that the large quantities of it imported tended to impoverish the nation, attempted, so far back as 1780, to find a substitute for it on their own soil. Several plants were tried. Succory was found the most suitable, and this plant is in consequence cultivated to a great extent in every quarter of the kingdom. It is not, however, used alone, but is mixed with coffee, making a very wholesome and delicious drink.

Animals. Cattle are raised in considerable numbers throughout all the provinces. Sheep are also common; but the country does not seem favourable for them, and their wool is not only different in quality in the different districts, but none of it is good except in Silesia. The breed has of late been much improved by the introduction of the Merino and Paduan rams, and the manufacturers are now supplied at home with the same species of wool which was formerly imported, particularly from Spain. Nor is the rearing of horses neglected, though the breed has not hitherto been brought to great perfection, as horses for the Prussian light infantry are imported from the Ukraine, and those for the heavy cavalry from Holstein. The marmot, a species of castor, and the lynx, may be seen in the uncultivated provinces of the east; but the bear and the elk are unknown.

Minerals. The level and marshy nature of the country is extremely unfavourable to the production of minerals. Iron ore, which makes a considerable object of manufacture, is found in many of the marshes; but little or nothing else of a mineral description can be said to occur, except in the mountainous districts of the Hartz, in Westphalia, and the mountains in the south of Silesia. In these districts there are mines of copper and lead; and there were formerly mines of gold and silver, but they are not now wrought, as the produce does not defray the expence. Chrysoprase, agates, jaspers, clear crystals of quartz, commonly called diamonds, calamine, cobalt, sulphur, saltpetre, alum, and vitriol, are also found. Salt from brine springs is common in some parts of Saxony. Coal occurs in several parts, chiefly at Schweidnitz, in Lower Silesia, as also in some parts of Saxony and Westphalia; but as wood is very abundant, and the conveyance of coal expensive, the latter is not very extensively used as common fuel. There are no mineral waters, if we except one at Warmbrun, in the south of Silesia.

Amber. But Prussia, though not otherwise eminent for mineral wealth, is possessed of one mineral production almost peculiar to itself, namely amber, a substance of great value in ancient times, but now sold in Prussia for a few shillings the hundred weight. It is chiefly found on the Samland shore of the Baltic, on a neck of land formed by the Frisch Haff, extending 25 miles from Pillau to Palmaixen. It is thrown on the coast by the waves, or fished like coral. It is also found in the interior of the kingdom, particularly in Polish Prussia, at the depth of about 100 feet, imbedded in strata of coal, in lumps of various sizes, some five pounds in weight, and is dug like the produce of other mines. By friction amber becomes electric; and the Greek name (ηλεκτρον) has been applied to designate the doctrines and philosophy of electricity. It is used to make trinkets, scented powder, a spirituous acid, and a fine oil used in varnishing, manufactures of it for these purposes being established at Dantzick, Konigsburg, and Stolpe, in Pomerania. It belongs to the crown, and being let to farm, adds £8000 to the royal revenue.

Manufactures. This country has attained considerable distinction in several departments of manufactures, chiefly in that of linen, the raw material of which is produced at home. "The rendering Prussia as much as possible independent of foreign countries, for various species of manufactures," says an able writer, "was a leading object in the domestic policy of Frederick the Great. In order to accomplish this, he loaded many foreign commodities with heavy duties, and established monopolies in several branches of commerce."—(Vide M'Culloch's *Essay on the Reduction of the National Debt*, page 107.) Thus one company had the sole right of manufacturing and selling tobacco, another were the sole importers of salt, while a third enjoyed an extensive contract to supply Potsdam with wood. The principle of restrictions is radically objectionable; but it not unfrequently, as in the present instance, promotes the cultivation and success of some particular branches of manufactures at home. The linen manufacture of Silesia, famous for ages, increased prodigiously after that province fell into the hands of Prussia, and partly perhaps in consequence of the policy, though otherwise objectionable, of Frederick. "The value of the linen," says the same author, "exported in 1740, did not exceed three millions of rixdollars, (about L.500,000 of English money.) In 1796, 26,456 looms, and 40,603 workmen, were employed in this branch of industry, whose manufactured produce was valued at 8,852,678 rixdollars, the exports amounting to 6,748,029. The neutrality enjoyed by Prussia during a great part of the late war was extremely favourable to this manufacture; and in 1805, previous to the unfortunate campaigns with the French, the value of the exported linen had increased to between 16 and 20 millions of rixdollars." (*Ib.* p. 108.) The disasters which Prussia experienced in 1806, and the subsequent hostilities in which she was engaged, greatly retarded the progress of the manufacture in question; but, as she is now availing herself more than ever of the advantages of peace, there is every reason to conclude that, in this species of industry as well as in others, she is making rapid improvement.—For much accurate and valuable information on this subject, the reader may consult *An Essay on the Reduction of the National Debt*, by J. R. M'Culloch, Esq. section third, which contains an elaborate and curious account of the progress of manufactures throughout Europe since 1775.

But though the linen manufacture is cultivated chiefly in Silesia, it also forms the staple manufacture in almost every other quarter of the Prussian dominions. In the provinces of Posen and Westphalia in particular, it is very extensively cultivated. And the number of looms employed in 1816 in the whole kingdom amounted to 207,870, being fully three times the number used in Silesia at the same period. The damask manufacture of Prussia is preferred to all others, in the higher circles in the whole of Europe. The manufacture of broad cloth is also carried to a great extent, particularly since the introduction of the Merino and Paduan breed of sheep; and the best kind of cloth is said to rival that of France or of England, and is about a half cheaper than that of the latter. Cotton works, though of recent introduction, have been established at Berlin, Erfurt, Elberfeld, and various other parts of the kingdom. This manufacture, however, is not destined to attain to great distinction, as the raw material must be imported. The Prussians also manufacture leather, earthen-ware, glass, paper, tobacco, starch, potash, vitriol, beer, brandy distilled from the native grains, and musical, optical, and mathematical instruments, with types, watches, and articles of a similar description. The want of coal is severely felt, but what Mr. M'Culloch says in reference to Silesia is applicable to the whole kingdom. "The low wages of labour, the great industry of the inhabitants, and the cheapness of provisions, will ensure the prosperity of its manufactures." The manufactures of Poland have been promoted, in no mean degree, by French refugees, who, after the revocation of the edict of Nantz, in 1685, sought an asylum in Prussia, and by their skill and industry roused the Prussians to exertion, and showed them their true interests. The descendants of these refugees amount in Brandenburg alone to about 10,000, who still remain a separate people, and retain their original habits and principles.

The situation of Prussia in regard to the number of her navigable rivers, and her various sea-ports on the Baltic, give her many natural facilities for commerce. But in opposition to these facilities, she labours under many disadvantages. The restrictions imposed by Frederick the Great and his predecessors, which, though sometimes beneficial in a rude country, where the people are strangers to mercantile or manufacturing industry, are found to be extremely pernicious in an improved country, have not yet been entirely laid aside in Prussia. Duties are still levied on goods imported into Prussia by the Rhine, and by the Hanoverian government on goods imported by the rivers that flow through their territories. And previously to 1818, a tax was imposed on the transmission of commodities from one province to another. The commerce of Prussia, however, has flourished to no mean extent, notwithstanding these disadvantages. But as she is possessed of no colonies, and her seaports, though exceedingly numerous, are not calculated to receive ships of a great draught of water, her commerce can scarcely be said to extend beyond the limits of Europe. The greater number of her exports are conveyed in foreign ships, of which the British exceed in number those of all other nations taken together. Linen is the great export of Prussia, and is indeed of so high a quality, and in such demand, that vast quantities of it are purchased in Holland, and sold there as if it were Dutch manufacture. Timber is also a great and permanent object of export, chiefly from the eastern provinces, though Brandenburg, it has been calculated, exports timber by the Elbe to the amount of one million of dollars. Notwithstanding the backward state of agriculture, Prussia, particularly the provinces wrested from Poland, exports corn in considerable quantities. The other chief exports are amber, wool, pitch, tar, potash, linseed, tobacco, horses, cattle, and from some districts, fish. The list of imports is as diversified as that of exports, including sugar, tea, coffee, and other colonial products, wines, silks, fruit, printed cottons, the finer kinds of hardware, furs, dyestuffs. The connexion of Prussia with Britain consists chiefly in her sending thither corn, (when the British ports are open,) and wood; and in her taking in return our manufactures and colonial goods. Memel, in East Prussia, is the largest commercial city. The other most frequented ports are Dantzick, Konigsburg, Elbing, Stettin, Magdeburg, Colberg, Stolpe, Swinemunde.

Of the several cities and towns of Prussia, (which are extremely numerous,) an account may be found in this work under their respective heads, to which we refer the reader for information on this subject. At present we shall merely give a list of the most important, with the number of their inhabitants, and a reference to their situation.

Towns.	Situation.	Inhabitants.
Berlin,	on the Spree,	160,000
Breslau,	Oder,	63,000
Konigsburg,	Pregel,	55,000
Dantzick,	Vistula,	45,000
Cologne,	Rhine,	30,000
Magdeburg,	Elbe,	29,000
Aix-la-Chapelle,	Rhine,	27,000
Halle,	Saale,	25,000
Stettin,	Oder,	21,000
Posen,	confluence of the Wartha and Proszna,	20,000
Potsdam,	on the Havel,	17,000
Elbing,	on the Elbing, which falls into the Frisch Haff,	17,000
Erfurt,	on the Gera, (Saxony)	16,000
Dusseldorf,	confluence of the Rhine and Dussel,	14,000
Dresden,	on the Elbe,	13,500
Treves,	Moselle,	13,500
Brandenburg,	Havel,	12,000
Frankfort,	Oder,	12,000
Stralsund,	Baltic, (Pomerania)	11,000
Coblentz,	confluence of the Rhine and Moselle,	11,000

These cities (20 in number) are the most populous; but there are altogether 26, which contain severally 10,000 inhabitants or upwards; 136 which have more than 3500, and less than 1000; 194 that amount to more than 2000, and less than 3500; 665 which contain less than 2000: making altogether the number of inhabitants in the cities to amount to 2,895,832.

Before the recent acquisitions, the Roman Catholic was the predominant religion; to which, however, scarcely a third of the inhabitants now belong. Calvinism and Lutheranism, the two chief divisions of the protestant faith, include about six millions and a half. The Mennonites, a species of anabaptists, amount to about 15,000; and 130,000 are Jews. There are also a few Moravian brethren, Unitarians, and members of the Greek church. Universal toleration is established on the most liberal and just principles: the different sects are equally under the protection of the government; and members of every denomination are alike eligible to every civil, judicial, and military office. In 1817, the three hundredth anniversary of the Reformation, the Lutherans and Calvinists agreed to lay aside their characteristic distinctions, and to unite themselves into one body, under the appellation of the Evangelical Confessions;—a union that is highly commendable, and which promises to be attended with the most beneficial effects; and in religious matters there is probably no country in the world more distinguished than Prussia for Christian harmony, liberality, and benevolence.

The liberality thus shown in religious matters, indicates no small degree of refinement and intelligence to exist in the country where it is exhibited. Prussia, accordingly, in point of literature and the diffusion of liberal knowledge, is probably inferior to no country in Europe, hardly even excepting England and France. In this respect, however, it must be confessed, it has attained to different degrees of eminence in the different provinces: those districts where the majority of the inhabitants are of the Catholic faith, are the most deficient; but, taking the whole Prussian dominions together, the remark made above is perfectly applicable. And the remark has been applicable to Prussia in a sense more or less limited for centuries. The great Copernicus, born 1472, was a native of Thorn. Cluverius, the celebrated geographer, and the friend of Scaliger, was born in Dantzick in 1560. Muller (commonly called Regiomontanus, from his being a native of Konigsburg) holds a high rank among the astronomers of the 15th and 16th centuries. Wolff, a man of unrivalled science, learning, and philosophy, was born at Breslau in 1679. Mendelsohn, a Jew, was one of the best supporters of the religious principles and views of his brethren that have yet appeared, and in general polemical divinity he has few superiors. We may also mention Ramler, the poet; Nicolai, a writer of romances; Busching, the geographer; Spalding, Klaproth, Humboldt, &c. Nor must the name of Frederick the Great, King of Prussia, be omitted; a prince who, though one of the most distinguished statesmen and generals of his day, is probably more frequently quoted and spoken of as an author and as a patron of literature, than in any other capacity. During his long reign, he not only cultivated literature himself, but exerted himself in promoting the advancement of it among all ranks in his dominions. He established schools in the various parts of the kingdom. Before his time, indeed, schools were pretty general, but the subsistence gained by the teachers was at best but small, and in most cases precarious, so that some other profession was generally found combined with that of instructor. "This was especially the case," says Mr. Adam, "in Upper Silesia. Frederick therefore issued an ordinance, that a school should be kept in every village, and that a competent subsistence should be provided for the schoolmaster by the joint contributions of the lord of the village, and of the tenants themselves." Seminaries were instituted (at the head of which was Felbiger, an Augustine monk,) for the proper instruction and discipline of those who were to become teachers. With each of these seminaries are connected schools, where the young candidates for the profession of a teacher are obliged to attend to learn the practice of the method, the theory of which they had previously obtained at these seminaries themselves. No young man can be admitted to teach without a recommendation of his fitness for the office from one of these seminaries. "The school-tax," continues Mr. Adam, "must be paid by the lord and tenants without distinction of religion. The boys must all be sent to school from their sixth to their thirteenth year, whether the parents are able to pay the school tax or not. For the poor, the school money must be raised by collections. Every parent or guardian, who neglects to send his child or pupil to school, without sufficient cause, is obliged to pay a double school tax, for which the guardian shall have no allowance. Every curate must examine weekly the children of the school in his parish." A general examination takes place annually; and a report on the condition of the schools, on the talents and success of the teachers, on the state of the buildings, and the attendance of the children, is transmitted to government. This is probably the most enlightened and effective system of national education to be found in Europe. In addition to these village seminaries, there is what are called burgher schools; and larger institutions still, termed gymnasiums, similar to the great schools or colleges of Eton and Winchester in England. The number of gymnasiums are 105, each containing from four to twelve masters, and the pupils are divided into five or six classes, and are taught the classics, mathematics, the modern languages, drawing, and similar accomplishments. There are various universities of eminence:—Berlin, Konigsburg, Breslau, Halle, Frankfort on the Oder, Geisswalde, Bonn. There are also an almost infinite number of other seminaries for instruction respectively in medicine, surgery, midwifery, natural philosophy, the veterinary and military professions, rural economy, &c. There are also separate theological academies for the Catholics and the different denominations of Protestants. The number of books published in Prussia is great; periodical literature, particularly newspapers, (no less than seventy-nine being published weekly in 1819) are also extremely common: and learning and intelligence are thus diffused throughout every corner of the kingdom. In almost every city may be found museums, some of them large and valuable,—and libraries, which are conducted on the most liberal footing; every respectable person, even though a stranger, having it in his power to avail himself of the advantages they can confer. The libraries of Berlin contain 390,000 volumes, those of Breslau 100,000, those of Halle 50,000, while those of the other cities are seldom less than the number last mentioned.

Liberty of the press.

From what we have advanced respecting the literature and literary institutions of Prussia, it may be inferred that the liberty of the press has been fully recognised. This, indeed, is virtually the case in as great a degree as in Britain, except with regard to low cheap political writings, which the censors of the press interdict. All books, it is true, must be submitted to censors ere they can be published; but the inspection thus exercised is merely nominal, with the exception just stated. The universities have an unlimited right of printing, without a previous censurate; and there are no restrictions on the importation of foreign works.

Language.

The provinces of which the Prussian dominions are composed having, till lately, belonged to different countries, a corresponding variety may be expected to obtain in the language of these newly united territories. This union is of too recent a date for the original difference between the several provinces to be softened down, or to have formed a universal standard dialect. And indeed centuries may elapse ere this result be obtained, as may be inferred from the analogous history of Wales, or the Highlands of Scotland, and various other places. The greater number of the inhabitants being of German origin, the high and low German is the predominant speech. The high German, indeed, is the national language, as it is the dialect of the court, and of the higher classes in society, and that invariably used in literary productions, in the churches, and in the courts of law. The French refugees, particularly those who sought an asylum in Prussia after the revocation of the edict of Nantes, (1685) so confused the German and French tongues, that their descendants now speak a dialect peculiar to themselves, and formed by the union and amalgamation of the two languages in question. In the provinces wrested from Poland, the language of that country is carefully cherished as a relict and a memorial of its former independence. In Silesia, the German is gaining ground, though in the mountainous districts, and in the tracks bordering on Poland, the ancient dialect of the country, which seemed to hold a middle rank between the Bohemian and the Polish, is still preserved. Some descendants of the aboriginal inhabitants of Prussia, like the Poles, retain their original Sclavonic dialect; and in the most easterly parts of the kingdom about 50,000 people have a peculiar language of their own.

The manners of the people are as various as their language, and from the same cause. The character of the original Prussians is dull and heavy, approaching somewhat to the phlegmatical features of the Dutch. Frederick the Great, who showed a decided taste for French manners, as well as French literature, imparted a tinge of contentment and vivacity to his subjects which is still retained. The German character prevails,—which consists in industry, activity, a regard to good morals, a reverence for religion, bravery, patriotism, inquisitiveness, a thirst for knowledge, hospitality, attachment to their chiefs, and loyalty to their sovereign. The Prussians are inclined to emigration, particularly the inhabitants of the German provinces; and except the British and Irish, they formed the largest proportion of emigrants in the New World. They are credulous, superstitious, proud of antiquity of family, and cherish the traditions and peculiar customs of their native country with uncommon eagerness and affection. They are, as in other countries, divided into classes. The high nobility, amounting to above 50 families, are those princes who were formerly petty sovereigns on their own estates. The lower nobility, above 200,000 families, enjoy preferable claims to certain offices in the army, the state, and the church. This division, however, into high and lower nobility, is merely nominal and practical, not recognised by law: and the exclusive privileges which they both long possessed have been gradually contracted, and they now enjoy few distinctions separate from the superior classes of society. The other classes are the burgers, or citizens, and the *bauers*, or peasants. The latter were, till lately, slaves *adscripti glebae*, as in various other parts of Europe; and having no direct interest in the commercial and political welfare of the nation, had very little spur to industry and patriotism, in neither of which, however, were they deficient. Their condition has been gradually ameliorated; and by the liberality of the present monarch (in September 1811) the last vestiges of their thraldom have entirely disappeared. They are allowed not only to purchase land and become proprietors, a benefit of which they are rapidly availing themselves, but, as in Britain, a Prussian, however ignoble his birth, may, by talents, energy, and integrity, elevate himself to the highest situations either in the state, the church, or the army.

The present revenue of Prussia is estimated at seven millions and a half sterling, more than double what it was during the reign of Frederick the Great, and considering the population and the circumstances of the kingdom, is as great in proportion as the £30,000,000 now levied in France. This revenue is derived from taxes on the land, on persons, on patents and licences, on stamped paper, and on a custom-duty on foreign productions. In those provinces lately obtained from the French empire, the same taxes continue to be levied that were paid to their former government. But nearly a third of the whole revenue is obtained from the royal domains, and other departments, namely, mines, game, coinage, posting, over all which the king exercises an hereditary right or royalty.

But though the king's official income be so great, there is no court in Europe less extravagant than that of Prussia, and the present sovereign pays, if possible, less attention to external splendour, or personal gratification, than any of his predecessors; and the revenue arising, as stated above, from the royal domains, is devoted principally to the service of the state, the expence of the royal household not exceeding the comparatively trifling sum of £200,000 annually.

The following list, which shows the revenue produced in each province, calculated in gulden, (equal to about two shillings British,) exhibits also their relative resources and opulence.

Silesia,	-	-	13,600,000
Saxony,	-	-	10,417,000
Brandenburg,	-	-	9,000,000
Juliers, Cleves, Berg,		-	8,670,000
Westphalia,	-	-	8,413,100
East Prussia,	-	-	8,100,000
Lower Rhine,	-	-	7,000,000
West Prussia,	-	-	3,750,000
Posen,	-	-	3,100,000
Pomerania,	-	-	3,000,000
			74,968,000 Gulden, or £7,520,000 Sterling.

The Prussian monarchs, though they have uniformly kept a strong military force, have been distinguished for economy in the management of the revenue. The father of Frederick the Great, with a revenue of only £1,200,000, left at his death, which took place in 1740, a well-replenished treasury, and a standing army of 76,000 men. And Frederick the Great himself, notwithstanding his expensive wars, and the extensive national improvements which he effected, at his death, in 1786, left £7,000,000 in cash. This sum the improvident habits of his successor not only soon dispelled, but he accumulated considerable debt. The present king, on his accession, (1797) used every method to redeem the debt which his father had bequeathed to him; and would, ere now, have been successful, had it not been for the rupture of 1806 with Bonaparte, and the subsequent hostilities in which he was engaged, and which the battle of Waterloo (1815) brought to a happy and splendid termination. The debt of Prussia is calculated to be about £26,000,000, part of which (£6,000,000,) is a loan from Britain. Of the currency of Prussia, about a seventh part formerly consisted of paper money, which has of late nearly disappeared, almost every thing being transacted by gold and silver coin.

The government of Prussia is more of a military description than perhaps any other on the Continent. This object has been uniformly the policy of the successive sovereigns; and at this moment, in a time of profound peace, the support of the military establishment requires more than the half of the whole revenue of the kingdom. The bravery and superior discipline of the Prussian army were celebrated even before the time of the great Frederick, under whose reign it attained to a degree of perfection in these respects altogether unrivalled. His present majesty, in regard to the army, is distinguished by the same spirit and views which animated his predecessors. During the late war, the number of Prussian troops exceeded 200,000 men, who, though not always victorious, exhibited on various occasions, particularly on the field of Waterloo, a display of military skill, and an ardour of bravery, that gained them the admiration of the world. The present number of troops on the peace establishment is about 160,000, exclusive of two species of militia, denominated the Landwehr and the Landsturm,—the former, which consists of men between twenty-five and forty years of age, is exercised but one day in the year in time of peace, but in war it becomes a disposable force, liable to be marched wherever its services may seem necessary; the latter, which consists of all males above forty years of age capable of bearing arms, is called out only on occasions of emergency; and then its duty is merely domestic, in maintaining internal tranquillity. The regular army is levied by a conscription, compelling every young man, when twenty years of age, to serve for a limited time. Almost all the males of the kingdom, it is thus evident, are either in the army, or are liable to be called out in cases of danger or alarm; a state of preparation which the long and open frontier of the kingdom probably renders necessary, particularly as it is environed by the great military powers of Russia, Austria, and France. There are, as stated under the head of literary institutions, good military schools in different parts of the kingdom, particularly at Berlin, Konigsburg, Breslau, and Stolpe, in Pomerania. The acquisition of Dantzick, and other ports on the shores of the Baltic, may perhaps in time render Prussia a maritime power: but at present she has no navy, all her attention and pride having hitherto been placed in her land forces. The greatest portion of the kingdom forms a part of the Germanic Confederation, and maintains a stipulated number of troops, (79,234, in time of war,) for its defence.

Government.

The government, as hinted above, is a military despotism; and though, like all northern nations, it once possessed a representative body, under the name of States, yet this body has been long unknown, the people having no voice or influence in any of the affairs of the nation. In some particular provinces, indeed, the States exist as in ancient times; but they seldom assemble, and they enjoy no legislative or executive authority, scarcely even dare make representations to the monarch; their authority and inquiry being confined exclusively to the regulation and management of the debts and expences of their respective districts. The people have of late, however, been awakened to a number of abuses, and to the necessity of electing a representative body, as in former times. The expectation of this reform is said to have inspired them with the spirit and patriotism which they displayed in the late memorable conflict with France. These expectations, however, whatever hopes may have been held out, have not yet been adequately fulfilled, though the king has made considerable improvements in the executive branch of the government. The crown is hereditary in the family of the present reigning monarch, descending to the oldest branch, whether male or female. The age of majority is twenty-one. The present family are Calvinists; but as there is no national religion, there is no legal religion prescribed to the king. The whole executive and legislative power is vested in the king, without responsibility or control. There is a council of state, to which nominally the administration is entrusted, consisting of members of the royal family, and of the ministers of foreign affairs, of the finances, of justice, of public instruction, of trade, of the public debt, of police, and of war. But the president of this council, to whom the heads of the different departments are responsible, and make weekly returns, is directed solely by the king, by whom he is nominated, and is uncontrollable by his colleagues. There are also provincial councils for the transaction of public business; namely, the superintendence of the police, the regulation of traffic, the collection of taxes, the administration of the laws, &c.; at the head of each council there being a president, who serves as a medium, or connecting link between the provinces and the sovereign. The affairs of the government, in all its departments, are managed with the strictest regard to economy, insomuch that, probably with the exception of the United States, it scarcely finds a parallel in the world.

Laws.

The present code of laws was originally formed by Frederick the Great upon the ancient customs and usages of the people, but not reduced to a regular and complete system till the time of his successor. There are courts of every gradation of dignity and authority; and the whole system is extremely simple, expeditious, and economical. Feudal or baronial jurisdiction is either entirely abolished, or contracted within very narrow limits. The nomination of the judges of the lower courts, which resemble our justice-of-peace courts, is vested either in the king, in the ecclesiastical dignitaries of the district, or, in those places obtained from Germany, by the *mediatised* princes.* The decision of these courts, except in very petty and unimportant cases, is not final. The second stage of jurisdiction is the *Oberlandesgerichten*, which are established in each government, and to which appeals from the lower courts are made: and the final appeal is to the High College of Justice in Berlin. The police is under separate jurisdictions, whose influence is extensive and various to a degree unknown in Britain. The police courts, for example, not only perform most vigilantly the duties which in this country are peculiar to them, but they also have the superintendence of the examination of those who wish licence to enter the medical profession, take cognizance of the assurance offices against losses by fire, and of the engines and other implements for preventing fires from extending. With all this diversity of interests, however, the police department is managed with much mildness and efficiency, greater attention being paid to the prevention than the punishment of crime. In the cities are Boards, under whose superintendence, buildings, sewers, the supplies of water and of food are placed. The affairs of the church are managed by provincial consistories. Commercial affairs are under the direction and control of a board of merchants, in several of the large cities, particularly Breslau, Konigsburg, and Swinemunde in Pomerania.

Royal arms and orders of knighthood.

The royal arms of Prussia are representative and emblematical of the different provinces of which the kingdom is composed. Thus, for Ducal Prussia, *argent*, an eagle displayed *sable*, crowned *or*; for Brandenburg, *argent*, an eagle displayed, *gules*, with semi-circular wreaths. —There are various orders of knighthood, of which the most important are the following: "The Order of Generosity," instituted by Frederick, elector of Brandenburg, the first king of Prussia, in 1685. The motto is "La Générosité." The same prince, on the day of his coronation at Konigsburg, in 1701, instituted the "Order of the Black Eagle," with the motto "Suum cuique." The king is always grand-master; the number of knights, exclusive of the members of the royal family, is limited to thirty; and all admitted into this order, with the exception of foreign princes, must previously be members of the "Order of Generosity." Frederick the Great founded three orders, namely, the "Order of Merit," in 1740; the "Order of St. Stephen," in 1754; and the "Order of St. John," in 1756. The "Order of Merit" is the most celebrated, and was instituted with the express design of rewarding meritorious individuals in arms, in literature, or in science, without regard to birth, religion, rank, or country. "Pour le Mérite" is the simple but appropriate motto.

It may not be improper to mention in this place, that few countries in Europe are more destitute of antiquities than Prussia. Nor can such be expected to exist in a country where the arts and sciences were totally unknown till a comparatively recent period; and where neither the Romans nor any civilized people ever penetrated to leave behind them monuments of their ingenuity and skill. There are, however, some Sclavonic idols, cast in brass; some pieces of coin as old as the twelfth century; and remains of castles and churches, of considerable elegance and magnificence. Berlin, Konigsburg, and Dantsick, (the last particularly, from its great antiquity,) contain many specimens of ancient architecture, which would do honour to Britain or to France.

The original inhabitants of Prussia were the Slavi or Sarmatae, in the east and north-east; the Vandals on the shores of the Baltic, or the north of Pomerania and the Suevi in the remainder of the kingdom. (Vide Murray's *History of European Languages*, § *Suevi et Sarmaticae*.) These people, particularly the first, have been represented as extremely savage and barbarous, insomuch that they used to drink the blood of the lower animals; were ignorant of the art of constructing huts, and lived in caves or under the shade of trees. Such rude tribes cannot be expected to afford materials for history; and hence little certain is known respecting them till the thirteenth century, when the territories which they occupied were wrested from them by the knights of the Teutonic order. This celebrated fraternity must be known to every reader. The Germans, after the death of Barbarossa, behaved with so much bravery in the Holy Land, that Henry, King of Jerusalem, the patriarch, and other princes, rewarded their valour by conferring on them certain privileges. The order in question was thus instituted. The persons belonging to it were originally called the knights of St. George; they afterwards were denominated Equites Mariani, or Knights of St. Mary. In 1190, they elected Henry Walpol, their first grand-master, a German, who had distinguished himself for wisdom and bravery; and in the subsequent year the Pope (Celestine III.) confirmed to them the privileges they already enjoyed, and conferred on them the title of Knights of the Teutonic Order; an appellation by which they afterwards became so famous, and which they obtained from the name by which Germany, their native country, was called. Having by donations and other means become opulent, and, consequently, powerful, and having been expelled, with the other Christians, from the Holy Land by Saladin, they were first introduced (1227) into the territories which we are considering by Conrade, Duke of Masovia, who, in opposing the pretensions of his uncle Boleslaus V. to the throne of Poland, availed himself of their assistance in the attempt. Conrade being unsuccessful, and peace being restored, the Teutonic Knights had the province of Culm assigned them. But they were of too ambitious and warlike a character either to remain long in peace, or to be contented with the limited territory which had been given them. No sooner indeed was peace concluded with Boleslaus, than they began to extend their dominions over the neighbouring districts, towards the north, and ere long obtained possession of Dantsick; a city even then of importance, and the inhabitants of which they butchered in the most cruel and savage manner. The cruelty thus shown so terrified the neighbouring cities and provinces, that they, without almost any exception, tamely submitted to their ruthless invaders. The increasing power, and the unrelenting tyranny of the Knights, awakened the fears and the displeasure of the church; and, accordingly, they were commanded by the Pope to renounce their conquests. They were now, however, become too powerful to yield even to this high authority, and submitted to be excommunicated rather than profess obedience, and resign the extensive acquisitions they had acquired. But the Pope was not the only enemy they had to encounter. Uladislaus, King of Poland, marched against them; and his armies were found to be more formidable than the anathemas of the see of Rome. After a bloody and desperate engagement, they suffered a complete defeat, though they were reinforced by the forces of the Dukes of Masovia and Brandenburg; the latter being involved in these hostilities as he had presumed to sell the right of certain lands to the Teutonic Knights. Had Uladislaus availed himself of the advantages this victory afforded him, he might have exterminated his enemies, and delivered that quarter of Europe from a class of men, who, for nearly three centuries, involved it in slaughter and blood, and who seemed to sacrifice every worthy principle to their own ambition and aggrandizement. But instead of pushing his advantages, he concluded a peace with them under the mediation of the kings of Bohemia and Hungary. The Knights, however, were not of a character to keep a treaty of peace long inviolate, however fair and desirable its conditions might be. In a few months they not only refused to evacuate Pomerania, according to their stipulations, but endeavoured to extend their usurpations in all directions. The Polish monarch, forced to march against them a second time, gained so decisive a victory, that 4000 Knights were slain on the field of battle, and 30,000 auxiliaries either killed or taken prisoners. Uladislaus was still influenced by the same feelings with regard to the Knights as formerly, and instead of extirpating them, he granted them peace, on the condition of the provinces which occasioned the war being ceded to him. Hostilities a third time broke out between Poland and the Knights; but through the good conduct and bravery of Plawen, their grand-master, an advantageous peace was again granted them. The Knights, notwithstanding the long series of wars in which they had been engaged with Poland, and the resistance made by the native tribes whom they attacked, were now (in addition to Culm, their first territory,) in possession of Samogitia, Masovia, Silesia, and Pomerania, and the provinces now denominated East and West Prussia. The original inhabitants of these countries were, of course, superseded by Germans, who, in a great degree, introduced new customs, new laws, and a new language. But the power of the Teutonic Knights was not always to continue. In the fifteenth century, after a series of discomfitures, they were completely subdued by Casimir IV. and obliged to surrender the territories of Culm, Pomerania, and other places to the Poles, on the condition that they should retain Prussia, (now East Prussia,) and that the grand-master of their order should have a seat in the Polish senate, and take an oath of allegiance and fidelity to Casimir and the republic. These conditions were too severe to be easily acquiesced in by this turbulent and enterprising people; and accordingly they endeavoured, though unsuccessfully, to throw off their vassalage to Poland. The last grand-master of the order was Albert, elector of Brandenburg, and nephew to Sigismund I. King of Poland. He was elected to this dignity in the hope that by his affinity to Sigismund he might obtain the restoration of parts of the territories forfeited to Poland, and might accomplish the removal of the vassalage they now were obliged to pay to that power. But these hopes were completely frustrated. Albert, in the first place, instead of using interest with his uncle for the restitution of the lost privileges of the Teutonic Knights, refused to do him homage, and endeavoured not merely to throw off his allegiance, but to recover by force of arms the provinces which his predecessors had surrendered to Poland. In the exhausted and dispirited state in which this order was then placed, the result of so imprudent an attempt may easily be conjectured. Albert was defeated at every step of his enterprise, and was at length compelled to resign the office and dignity of grand-master; in return for which, however, Sigismund conferred on him the title of Duke, and the province he had enjoyed as grand-master. Previously to this change of title and of rank, he had to consent to lay aside the habit and the tenets of the order over which he presided, to embrace Lutheranism, and to consent to hold his dominions as a fief of Poland. The title and possessions were to descend (on the same conditions as those by which he held them) to his heirs male, and upon failure of his direct lineage, to revert to his brother or his male issue. This event took place in 1531, nearly three centuries after the time the Teutonic Knights obtained the grant of the territory of Culm. Albert, now interested in expelling this fraternity from his dominions, did not rest till he had accomplished this object. The Knights transferred their chapter to Mariendal in Franconia; and though once so powerful and so celebrated, they gradually sunk into an obscure and unimportant people; and at this day little more than their name now remains.

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* The appellation *mediatised* is applied to those German princes who, by the terms of the Confederation of the Rhine, (1806,) confirmed by the Congress of Vienna, (1814 and 1815,) were reduced from the rank of petty sovereigns to that of nobles, and were declared to hold no longer immediately of the Emperor, (originally of Germany, but since 1806 of Austria,) whose power was at the same time confined to his hereditary states. The number of the mediatised princes amounts to eighty; and they, together with the various sovereigns to whom they belong, and among whom Germany has been parcelled, are now formed into a federative body, denominated the Germanic Confederation, governed by a diet. The original number of votes were sixty-nine, of which Prussia had four; but as this put the smaller states nearly on a footing with the larger, seventeen have lately been fixed as the number of votes. It is thus evident that the petty states have in a great degree merged into the larger. So much indeed is this the case, that the influence of Prussia extends over nearly a half of the Confederation, and that of Austria over the other. The military force of this body is fixed during peace at 120,000 men; but in time of war it is to amount to 301,000, (making one to a hundred of the whole population,) of whom Prussia contributes 79,234, and Austria 94,822, leaving 126,944 to be supplied by Hanover and the remaining states.

Albert elector of Brandenburg, grand-master of the order.

The house of Brandenburg.

Albert being descended of the house of Brandenburg, and being the founder of a dynasty which has now attained to such eminence, it may not be improper to turn back and give a brief account of the family to which he belonged, and of which the present sovereign of Prussia is the representative. This family, (Hohen Zollern,) which is one of the oldest in Europe, had its origin in the south-west of Germany. From the earliest periods they possessed a petty principality in Suabia, and occasionally held the office of burg-grave or governor of the castle of Nuremburg. They seem, even in that rude age, to have been distinguished for prudence, economy, and a well-regulated desire of improving their hereditary importance. They found means to render the office of burg-grave hereditary in their family; in 1248, they obtained the principalities of Bayreuth and Anspach, in Franconia; and, in 1415, Frederick, burg-grave of Nuremburg, purchased the margraviate of Brandenburg, for the sum of 400,000 ducats.* Frederick was now raised to the dignity of elector, and arch-chamberlain of the holy Roman empire; and the purchase of Brandenburg was, two years after it was made, sanctioned and confirmed to him and his family at the diet of Constance. But he was not possessed of the full extent of Brandenburg; the New Mark being in the hands of the Teutonic Knights.† Frederick, instead of adhering to the feudal practice of leaving his whole possessions to his oldest son, at the expence of his other children, divided his territories among his children, nearly in an equal degree. The spirit of the feudal times was soon, however, resorted to; and in 1473, it was agreed that the electorate of Brandenburg should from that date remain undivided, and should descend to the nearest heir male. Frederick was succeeded as elector by his second son of the same name; the oldest having been disinherited because he had applied himself too ardently in endeavouring to find out the philosopher's stone. Frederick, the second elector, was a man of uncommon merit, prudence, and equity. He refused, for example, the crown of Poland, when offered him by the people, because, as he conceived Casimir, son of the late king, to have a prior claim, he declared he would not accept of it unless that prince refused it. This generosity was not without its advantages. The states of Lower Lusatia, admiring his conduct, made to him a voluntary surrender of their country. Lusatia, however, being a fief of Bohemia, war was immediately declared to recover it. This attempt was not entirely successful, for though the Bohemian king recovered Lusatia, he was obliged, by a treaty concluded in 1462, to yield the perpetual sovereignty of other states to the elector. Frederick having thus augmented his dominions, and having purchased the New Mark from the Teutonic Knights for 100,000 florins, he resigned his crown to his son Albert, of whom we have already spoken, as grand-master of the Teutonic order.

Character of Albert.

And Albert, in many respects was not unworthy of being elevated to so eminent an office among this warlike and brave people. His name stood as high as that of any monarch in Europe. He had routed and taken prisoner Louis, duke of Bavaria. He had gained no fewer than eight battles against the Nuremburgers. At the siege of Greifenberg he had performed prodigies of valour, having leaped from the walls into the town, and defended himself till his men forced the gates and came to his assistance. He had also it seems gained the prize at seventeen tournaments; and so high and indisputable were his merits, that the emperor entrusted to him almost the whole direction of the empire. It was a person thus distinguished that the Teutonic knights raised to the dignity of grand-master of their order. Notwithstanding, however, all the confidence they showed towards him, he disappointed their hopes, and did not in any sense sustain the high character he had before acquired. The result has already been mentioned. The interests of the order were betrayed and destroyed; and having become protestant, and promised allegiance to Poland, he obtained the title of Duke, and the sovereignty of Prussia, for himself and descendants. The Prussian annals are barren and uninteresting for a considerable time after this date. John Sigismund, elector of Brandenburg, who married Anne, daughter of Albert, duke of Prussia, died in 1619, and was succeeded by his son Frederick William. It was during this reign hostilities commenced between the Catholics and Protestants, which is commonly called *the thirty years war*. George William acted a very weak and fluctuating part, and though a protestant, would not have hesitated to sacrifice his principles, and abandon the cause which he had espoused, had it more thoroughly promoted his safety, or secured his aggrandizement. He was succeeded on his death, in 1640, by his son Frederick William, usually denominated the Great; a prince of great decision of character, of great military talents, and eminent personal bravery; and though only twenty years of age on his accession, began to repair the losses and destruction occasioned by the wars in which his father had been engaged. He concluded a treaty of peace with Gustavus Adolphus of Sweden, who agreed to evacuate the territories of Prussia which he had seized upon. By treaties also made with the Hessians and Dutch, he added considerably to the extent of his dominions; and in the meanwhile continued to adhere steadfastly to the Protestant cause. The powers of Europe, however, wished to bring to a termination a war which had raged so long with the most unrelenting severity, and which was exhausting the resources of their several dominions, without acquiring them any solid advantage in return. A treaty was therefore concluded in 1647, commonly called the peace of Westphalia, by which, among other arrangements, the bishoprics of Minden, Halberstadt, Magdeburg, and Camin, and the lordships of Hochenstein and Richenstein were ceded to the Duke of Prussia. Prussia, however, was not destined to remain long at peace. The Swedes having invaded Pomerania, part of which had been assigned to Prussia by the treaty of Westphalia, Frederick William marched to oppose them; defeated them with great slaughter; and ultimately carried his victorious arms into Sweden, where the enemy experienced several signal defeats, and might have been almost extirpated, had an interposition not been made in their favour by the celebrated generals of France, Turenne and Condé. Peace was in consequence agreed upon by the contending parties; and it was stipulated, that the Duke of Prussia should possess the customs in all the ports of Further Pomerania, with the cities of Camin, Gortz, Greifenberg, and Wildenbruck. With this treaty, which was called the peace of St. Germaine, terminated the military career of Frederick William, who passed the remainder of his days in tranquillity, and in promoting the best interests of his dominions. Few sovereigns ever attained to greater celebrity, or enjoyed more deeply the affections of their subjects, and the respect of foreign countries. An embassy was sent him by the Cham of the Tartars, craving his alliance. The Protestants, who in 1685 fled from France, took refuge, as we formerly mentioned, in Brandenburg, where they were received with affection and kindness. The Duke died in 1688, carrying to the grave the love and regret of his subjects. Prussia, before his time, was held as a fief of the Polish monarchs; but in 1656, he compelled the king of Poland to declare it an independent state. The great Puffendorf thought the life of this duke a subject not unworthy of his pen: and Frederick the Great, in his *Memoirs of the House of Brandenburg*, regards him as the chief founder of the power of that family.

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* The margraviate of Brandenburg was founded in 927, by the Emperor Henry I. and was first conferred on Sigefroy, his brother-in-law. From its institution till, as mentioned above, it was purchased by Albert, burg-grave of Nuremburg, no fewer than eight different families successively held the office of margrave of Brandenburg. The margraves of Brandenburg, after the year 1100, enjoyed the dignity and title of elector and duke.

† It may not be improper to state, that Brandenburg is subdivided into New Mark, Old Mark or Alte Mark, Middle Mark, and Ucker Mark.

ick I.

His son Frederick, who succeeded him, finding himself possessed of extensive dominions, and of no inconsiderable influence among the nations of Europe, and being besides fond of show and splendour, aspired to the regal dignity. For this purpose, he used every means to insinuate himself into the favour of the emperor, and at the suggestion of William III. king of Britain, joined with the emperor in an alliance against France. The object of his ambition was at length obtained on terms sufficiently liberal and honourable, and he was crowned king at Konigsberg in January, 1701, under the name of Frederick I. the emperor himself placing the crown on his head. Some of the terms on which this dignity was acquired were, 1st, That Frederick should not separate from the empire those portions of his dominions which had formerly been dependent on it; 2d, That in the emperor's presence he should not experience any marks of honour superior to those he had before enjoyed; but that his ministers at Vienna should be treated with the same distinction as those of other crowned heads; 3d, That Frederick should maintain at his own expense 6000 men in Italy, in case the emperor should be obliged to make war on account of the claim of the house of Bourbon to the throne of Spain, and that these troops should be continued there while the war lasted. Such were the most important of the terms on which Prussia was erected into a kingdom. Frederick showed himself not unworthy of the honours he attained. He was a pacific and patriotic prince, and exerted himself to improve the internal advantages, and to secure the stability of his possessions. He was succeeded, in 1713, by his son Frederick William, sometimes called Frederick II. a great statesman, and with dispositions decidedly military, though he never was engaged in actual hostilities. He devoted himself, however, to the augmentation of his army, already great, and to the discipline of the troops. The army was composed of the tallest men he could find in his own dominions, and he did not scruple to violate national faith in picking up the subjects of other states to answer his purpose; a circumstance which was more than once the occasion of altercations, and almost of hostilities. Before his death the Prussian army was not only one of the most numerous, but the best disciplined and accoutred of any in Europe. This object he kept steadily in view, both from the inherent taste and tendency of his mind, and from the necessity of maintaining an attitude of preparation and of readiness to keep the house of Austria in awe, which was now regarded as the natural enemy and rival of Prussia. During Frederick William's time, though some misunderstandings took place, war never was declared between these powers; but from the state in which he left his army, and from the funds he had accumulated, he put it in the power of his son to perform exploits not surpassed in number and in brilliancy in modern times.

Frederick the Great.

His son, Frederick II.[*] commonly and deservedly styled the Great, came to the throne in 1740. His mother was Sophia, daughter of George I. king of Great Britain. He was born on the 24th of January, 1712; and was entrusted in his infancy to the care of Madame de Rocoule, who spoke only in French; a circumstance that has been regarded as the origin of his uncommon taste for that language, and his dislike of the German, his native tongue. As he advanced in years he was put under more accomplished tutors, to whose instructions he uniformly paid the most marked attention; but as his father's object was to inspire him with a love of military glory, and to teach him the art of war in all its departments, he made at first but comparatively little progress in science and literature. And, indeed, though a man of uncommon genius, and of very general attainments, his erudition was at best but limited, being acquainted, for instance, with the classical writers of antiquity chiefly through the medium of French translations. The branches in which he excelled were the belles lettres and moral science. He was also an adept in music, and passionately fond of it; an accomplishment which his father seems to have reckoned incompatible with the profession of a soldier, as he strictly forbade him to practise it—a restriction which was the chief cause of that misunderstanding which obtained between them for several years previously to the death of Frederick William. In consequence of this misunderstanding, he retired to the castle of Rheinsberg, where he devoted his time to study, to the most refined and elegant amusements, and to the society and conversation of the learned from almost every country. When he ascended the throne in 1740, he was welcomed by the unanimous acclamations of his subjects, who entertained hopes of his future greatness and celebrity, which were not disappointed. Under the article Frederick III. in this work, (Vol. IX. page 748,) we have given a full and minute account of the military achievements of this distinguished monarch; and referring our readers to that article for farther information on this subject, we shall at present state, in the most cursory and brief manner, only the most important transactions of his reign. In accordance with the uniform policy of his family, the early and great object of his life was to increase his dominions; and the first step he took in the accomplishment of his wishes, was the invasion of Silesia on the death of the emperor of Germany. Disregarding the Pragmatic Sanction, by which all the powers of Europe had engaged to secure the emperor's hereditary claims to his eldest daughter, the Archduchess Maria Theresa, he took possession of Silesia with an army of 30,000 men. And after reducing several cities, and defeating the Austrians at Molwitz, he entered Breslau the capital, and received the homage of the Silesians.[†]

This invasion of Silesia, though it could not be preritories as seemed consistent with the permanency and security of the balance of power in Europe. The following are the new territories conferred on Prussia by the congress of Vienna,—from France, the Lower Rhine, and part of Juliers, Cleves, and Berg; from Westphalia, Munster, and the remaining part of Juliers, Cleves, and Berg; and from Saxony,[*] Thuringia, Upper and Lower Lusatia and Menneberg, which latter provinces contain about a million of inhabitants, and are situated on the north and east of the Saxon dominions. We have already stated, that in this year also, Prussia, partly by exchange, and partly by purchase, obtained from Denmark that part in the west of Pomerania, commonly called Swedish Pomerania, with the island of Rugen. And thus we see Prussia, by her own energy and exertions, again raised from the condition of a second rate power, to be one of the first sovereign states of Europe, and as formidable as she was even in the time of Frederick the Great.—Frederick William III. in whose reign the above memorable events took place, forms one of the members of the Holy Alliance, and enters with eagerness into all the views by which that body is distinguished; and in some respects he carries despotism in his own dominions, to a height which in Britain would be reckoned intolerable. But, in opposition to this, he is, as previously mentioned, assiduous in other respects in promoting the best interests of his subjects: he has made several judicious improvements in the legal code of the kingdom, and in the administration of justice; he encourages literature, agriculture, trade, and manufactures; he has established the liberty of the press; and he has even promised a representative government to his subjects,—a measure for which a decree was issued, dated at Vienna 1815, though it has not yet been carried into execution. At the present date the Prussians, finding that their country holds a distinguished rank among the nations of the continent; that they are making rapid progress in all the arts of peace and national prosperity; and that their property and privileges are protected and held sacred, are characterized by as much contentment, patriotism, and attachment to their sovereign and government, as they displayed at any previous period of their history.

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[*] This monarch is more properly designated Frederick II. than Frederick III. as in the regal genealogy the name of Frederick alone is regarded as distinct from Frederick William. In this case, the father of Frederick the Great is denominated Frederick William I. and not Frederick II.

[†] The history of Silesia, though not very important, requires not to be passed over in silence. The original inhabitants (of Suevic derivation) were displaced in the 6th century by a Sclavonic tribe named *Zlesy*, whence the name in the Polish speech is *Zlesien*. Christianity

See *Travels* by Marshall, (supposed to be written by Sir John Hill) Coxe, Riesbeck, &c.; *Letters on Silesia*, by Adam, minister plenipotentiary from the United States, 1801; *Tableau de la Pologne*, par Malte Brun, Paris, 1807; Hoeck's *Apperçu Statistique des Etats d'Allemagne*, Paris, fol. 1801; *Statistische Darstellung der Preusische Monarchie*, von J. A. Demain, 1818: Reichard's *Guide des Voyageurs*, Weimar, 1805; Wraxall's *Memoirs;* see the following works by Frederick the Great, *Memoirs of the House of Brandenburg; Memoirs of his own Times, from* 1740 *to the Peace of Dresden; A History of the War of Seven Years;* and *A History of the Transactions from the Peace of Hubersburg;* see also the various *Lives of Frederick the Great;* the *Annual Register*, particularly for 1806, 1807, 1814, and 1815; and in this work, the articles Austria, Frederick III. Germany, Poland. (&)

PRUSSIAN Blue. See Dyeing, vol. viii. § 118, 119, 354, 356, 357, 389.

PRUSSIATES. See Chemistry, vol. vi. p. 87; and Dyeing, vol. viii. § 120.

PRUSSIC Acid. See Chemistry, vol. vi. p. 60; and Poisons, vol. xvi. p. 719.

PTOLEMIES. See Egypt, vol. viii. p. 369—378. Astronomy, vol. ii. p. 59; Music, vol. xv. p. 38; and Optics, vol. xv. p. 461.

PUERPERAL Fever. See Midwifery, vol. xiv. p. 259.

PUFFENDORF, Samuel, a celebrated historian and jurist; was born at Floha, near Chemnitz in Misnia, in Upper Saxony. His father, who was a Lutheran clergyman, educated him under his own eye; but when he was sent to Leipsic to study divinity, he acquired a taste for the study of law, which he ever afterwards prosecuted with ardour. From Leipsic he went to Jena to study mathematics under Weigel, and having acquired a competent knowledge of them, he devoted himself to the law of nations and the politics of the Germanic body. In 1658, he was appointed governor to the Swedish ambassador at the court of Denmark; and when a quarrel arose between the two nations, he was put under arrest at Copenhagen along with the rest of the family of the Swedish ambassador. During this confinement, which lasted for eight months, he wrote commentaries on Grotius's work, *On the Rights of War and Peace*, and on the political writings of Hobbes; and, having arranged his observations, he published them under the title of *Elements of Universal Jurisprudence*, which appeared in 1660. This work acquired much reputation to its author, and induced the Elector Palatine to establish for Puffendorf a professorship of natural law in the university of Heidelberg. The king of Sweden gave him the same office in the university of Lunden in 1670. After the publication of his *Treatise on the Law of Nature and Nations*, Professor Beckman published a libel against him, for which he was banished the kingdom. This punishment exasperated the professor to such a degree, that he sent a challenge to Puffendorf, who, however, declined to take any notice of it. Having gone from Lunden to Stockholm during the prevalence of the war in Schonen, he was honoured with the dignity of baron, and was appointed royal historiographer and counsellor of state. Here he composed his *History of Sweden from the expedition of Gustavus Adolphus into Germany, to the Abdication of Christina;* and also his *History of Charles Gustavus.*

The elector of Brandenburg, with the consent of the king of Sweden, invited our author to reside at his court as a counsellor of state, and with the view of writing the *History of Frederick William.* This great work, which was not published till the death of its author, appeared in 1696, entitled, *The History of Frederick William II. the Great, Elector of Brandenburg.* It occupies two folio volumes, and was composed from materials in the archives of the house of Brandenburg. Complete copies of it are said to be very scarce.

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[*] Saxony, during the struggles we have been recording, was in alliance with France; and Bonaparte changed the title of elector to that of king, (which still continues) and added to his dominions the duchy of Warsaw. During the eighteen months which elapsed between the battle of Leipsic and the congress of Vienna, the Saxons were in dreadful suspense respecting the ultimate fate of their country. The dismemberment which took place was not altogether unexpected. The king, however, firmly remonstrated, and protested against the measure; but at length fearing that hostilities might be the result of longer-continued resistance, he was obliged to acquiesce. "All my efforts," says he in an affecting farewell address to his subjects, "all my efforts to avert so painful a sacrifice have been vain. I must part from you; and the bonds which your fidelity and attachment to my person render so dear to me,—the bonds which have formed for ages the happiness of my house and of my ancestry, must be for ever broken."—(*Annual Register for* 1815.)

Baron Puffendorf died at Berlin in 1694, of an inflammation in his feet, occasioned by cutting his nails, and left behind him a high reputation for integrity and honour.

His other works, besides those we have mentioned, are, *An Introduction to the History of the principal States at present in Europe*, with a *Continuation;* and an Abridgment of his Treatise on the Law of Nature and Nations, entitled, *Duties of a Man and a Citizen.*

His elder brother Isaiah, who died in 1689, was the author of a satirical work, entitled, *Anecdotes of Sweden, or a Secret History of Charles XI.*

PULLEY. See MECHANICS, Vol. XIII. p. 525.

PUMICE STONE. See MINERALOGY, ÆTNA, and VOLCANO.

PUMPS.

PUMP is the name given to a well known engine for raising water above its natural level. It was invented by Ctesibius, as we have already stated in our *History of* HYDRODYNAMICS, but has received many improvements in modern times. In giving an account of the most important variations which this engine has undergone, we shall begin by describing the three forms in which it generally appears, viz. the sucking pump; the lifting pump; and the forcing pump.

1. *Description of the Sucking Pump.*

The sucking pump is represented in Plate CCCCLXX. Fig. 1. where ABDC is called the *barrel*, and CDEF the suction pipe, which are joined to one another by flanges at CD, (if they are made of cast iron,) so as to be perfectly air tight. The lower end of the suction pipe is immersed in the water to be raised, and generally has a grating across it to prevent the entrance of extraneous substances. The piston *c d*, attached to the lower end of the spear or rod *a b*, is a hollow cylinder, and has its exterior circumference formed of leather, so as to move tightly in the barrel ABCD, without permitting any air to pass between it and the barrel.

In the centre of the piston there is placed a valve *v* opening upwards, and at CD another *x* of the same kind, the construction of which is shown in Figs. 2. and 3. In Fig. 3. CD corresponds with CD in Fig. 1, and 1, 2, 3, 4, are the screw holes of the flanges. Upon this plate, with a part NL cut out, there is applied a ring of thick leather NKL; and another piece of strong leather NR, composing the valve, has its end N placed in the opening NL. The circular part of the leather or valve NR, is of a greater diameter than the opening in the leather NKL, but is not so great as to fill up the circle GKI, *Fig. 3.* Two brass plates, the uppermost of which is seen at R, are used to strengthen this valve, the under one being a little smaller than the aperture in the valve plate, and the upper one a little larger than that aperture.

When this plate is inserted at CD, the tail of the leather valve at N will be compressed between the plates, and will become a hinge, on which the valve can rise or fall. A valve nearly similar is placed at *v*.

The operation of the pump will now be readily understood. When the piston *c d* is depressed towards CD by the power of a man working at the rod or spear *a b*, the air between *c d* and CD forces up the valve *v*, and occupies the space passed through by the piston *c d*; but upon drawing up the piston towards AB, the pressure of the air above *c d* shuts the valve, and consequently all the air in the barrel below *c d*, and in the suction pipe, is rarefied. The atmospheric air being no longer balanced by that in the pipe, the equilibrium can only be restored by the water at the bottom of the suction pipe rising a little in that pipe. By depressing the piston a second time, and again drawing it up, the air below *c d* is again rarefied, and the water rises a little higher in the suction pipe, till by successive strokes of the piston the water rises through the valve, and pressing the valve down by its weight remains there. If the piston is now made to descend in the water above CD, it will rise through the valve *v*, and will be lifted up by raising the piston into the reservoir MN, from which it may be conveyed by a spout or pipe for use. Hence it is obvious, that whenever the piston *c d* is raised, the valve *x* will rise, and the valve *v* fall, and *vice versâ.* As the whole pressure of the atmosphere is equal to about a column of water of 32 feet, the perpendicular height of the piston *c d* above the surface of the water in the well must never exceed 32 feet.

2. *Description of the Lifting Pump.*

Description of the lifting pump.
PLATE CCCCLXX.
Fig. 4.

The *lifting pump,* which, properly speaking, is only the *sucking pump inverted,* is shown in Fig. 4. In this pump, the spear or rod of the pump consists of a frame *a m b*, *a n b*, to which is fixed the piston *c d*, with its valve *v* opening upwards. At the flange CD there is also another valve *x* opening upwards.

Let this apparatus be now immersed in water, whose surface is WW, and let the piston be drawn up to CD. When the piston is permitted to descend by its own weight, the valve *v* will open, and the water will rise till it fills the barrel. If the piston is now drawn up by a power at *a*, the valve *v* will shut, and the piston *c d* will push the water upward through the valve *x*, into the rising pipe or main CDEF. By again letting down the piston, the valve *x* will shut by the weight of the superincumbent water, and the water below will again rise into the barrel through the valve *v*.

3. *Description of the Forcing Pump.*

Description of the forcing pump.
PLATE CCCCLXX.
Fig. 5.

The forcing pump, represented in Plate CCCCLXX. Fig. 5. consists of a working barrel ABCD, a suction pipe CDEF, and a main or rising pipe DGH. The piston *c d*, fixed to the spear or rod *a b*, is solid, and forms a kind of double cone, which is widest at the middle, being covered with two hoops of strong leather. At CD there is a valve *v* rising upwards, and another *x* of the same kind in the rising pipe at *e f*.

When the piston *a b c d* is pushed downwards, it drives the air before it, closing the valve *v*, and opening the valve *x*. Upon drawing up the piston, the air in the space D*f e* now expands in the barrel, and the valve *x* is shut by the superior pressure of the atmosphere. From the rarefaction of the air in the barrel the equilibrium of the air above and below the valve *v* is destroyed, and consequently the predominating pressure of the air in the suction pipe CDEF lifts the valve v, and expands into the barrel. The whole air in the suction pipe being thus more rare than that of the atmosphere, the pressure of the latter upon the surface of the water will force it up a short way in the suction pipe, till the equilibrium is restored. By a second stroke of the pump the same effect is produced, and the water rises a little higher in the suction pipe, till it gets into the barrel, when it will be forced up the main or rising pipe DHG by the descent of the piston $c\,d$.

In examining the operation of this pump, it must be obvious that it begins its action as a sucking pump, and finishes by being a lifting pump. On this account the piston is made with a double cone, as the air and water would pass by the sides of the lower cone when the piston is drawing up; but this is prevented by the leather of the upper cone applying itself to the surface of the barrel.

Forcing pump with air vessels. PLATE CCCCLXX. Figs. 6, 7.

As the forcing pump works by starts, it must obviously furnish an intermitting stream of water. There are many cases, particularly in fire engines and watering engines, where it is desirable to have a constant current; and this effect may be obtained very simply, by the application of an air vessel MN, Fig. 6. and 7. which is fitted upon the main or rising pipe of the forcing pump. In both these figures, the parts of the forcing pump to the left of, and below the valve $e\,f$, are exactly the same as that in Fig. 5.

In Fig. 6. the air vessel MN is joined laterally to the rising main pipe; and in Fig. 7. it surrounds an interruption of the main GH. In order to explain the action of these air vessels, let us suppose that the pump has received water above the valve $e\,f$, a part of that water will get into the vessel MN, and compress the air within it with a force proportional to the height of the column in the main GH. The next stroke of the piston draws up more water, and raising it higher in the main, the air in the air vessel is more powerfully compressed. When the water is at last raised to the place where it is to be delivered, or to the end of the main from which it is to issue, the air in the air vessel is so much compressed, that it balances the whole height of the column above it. Now, if the aperture at the top of the main, from which the water flows, were large enough to allow the water to issue with the same velocity as that of the piston, it would flow peaceably over, rising no higher by each successive stroke, and occasioning no additional compression of the air in the air vessel. But if the aperture of the main is diminished to half its size, the water forced up by the piston has not time to issue during the stroke, and consequently a part of it must go into the air vessel, and increase the compression of the included air. If the piston has now ended its stroke, and raises no more water, the compression of the air in the air vessel exceeding the pressure of the water in the main, the air will press upon the surface $w\,w$ of the water in the vessel, and force it out at the aperture of the main in an uniform current, while the piston is returning to make another stroke.

4. *Description of an Improved Lifting Pump.*

Description of an improved lifting pump. PLATE CCCCLXX. Fig. 8.

This pump, shown in Plate CCCCLXX. Fig. 8. is a sucking pump, converted by a slight addition into a lifting pump, and fitted for propelling water with any velocity and to any required distance. Near the top of the working barrel ABCD of a sucking pump, is joined the pipe Fef, terminating in a rising main efGH. The top of the barrel AB is terminated with a strong plate AB $m\,n$, and a stuffing box AB, through which the polished piston rod $a\,b$ works air-tight like the piston rod of a steam-engine, so as to prevent either the escape of air or water. The piston $c\,d$, which is hollow, has a valve y opening upwards; and there is a similar valve v at the lower end CD of the barrel, and there may be advantageously placed a valve x at the bottom ef of the main, though it is not necessary.

Let the piston cd be now supposed to be down near v. When it is drawn up it pushes up the air above it, (which will keep down the valve y) driving it through the valve x in the main where it escapes. The air between cd and v will now expand into the upper part of the barrel below the piston, and it will be rarefied to such a degree, that the predominating pressure of the atmosphere upon the water below will raise it in the suction pipe. When the piston again descends, the air displaced into the barrel from the suction pipe by the ascending water, will get through the valve y, and, upon again drawing up the piston, this air will be driven off and escape through the rising pipe as before. The water is at last brought into the working barrel by repeated strokes. It gets through the valve y when the piston is down, and when the piston is drawn up, the water is drawn up along with it, and forced up the rising pipe through the valve x.

The advantages of this pump are, 1. That the rarefaction can be made very complete by bringing the piston near the bottom of the working barrel; 2. That the piston-rod being pulled in place of pushed, is less liable to be bent; 3. That the parts of the pump are more accessible for repairs; and, 4. That while by putting a cock at x, water may be obtained for common purposes; the pump, by merely shutting this cock, may be used also for extinguishing fire, or for conveying the water to distant places.

5. *Description of the Forcing Pump with a Solid Plunger.*

This pump, shown in Fig. 9. differs from the common forcing pump only in the substitution of a solid plunger ab in place of a piston of the usual form. This plunger is turned truly cylindrical, and polished, and its diameter is a little less than that of the inside of the barrel. It slides through a collar of leathers AB, which Dr. Robison has described in the following manner: "The top of the barrel terminates in a flanch AB, pierced with four holes for receiving screw bolts. There are two rings of metal of the same diameter, and having holes corresponding to those in the flanch. Four rings of soft leather of the same size, and similarly pierced with holes, are well soaked in a mixture of oil, tallow, and a little rosin. Two of these leather rings are laid on the pump flanch, and one of the metal rings above them. The plunger is then thrust down through them, by which it turns the inner edges downwards. The other two rings are then slipped on at the top of the plunger, and the second metal ring is put over them, and then the whole are slid down to the metal ring. By this the inner edges of the last metal rings are turned upwards. The three metal rings are now forced together by the screwed bolts, and then the leathern rings are strongly compressed between them, and made to grasp the plunger so closely that no pressure can force the water through them. The upper metal ring just allows the plunger to pass through it, but without any play, so that the turned up edges of the leathern rings do not come up between the plunger and the upper metal ring, but are lodged in a little conical taper, which is given to the inner edge of the upper plate, its hole being wider below than above. It is on this trifling circumstance that the great tightness of the collar depends. To prevent the leathers from shrinking by drought, there is usually a little cistern formed round the head of the pump and kept full of water."*

The operation of this pump is almost exactly the same as that of the forcing pump. When the bottom *b* of the plunger is in contact with *v*, it nearly fills the barrel. By drawing it up, a vacuum is made in the barrel. The valve *x* is shut by the pressure of the atmosphere above, and the air below CD rushes through the valve *v* into the barrel, and is followed by the water, which rises in the suction pipe. The same operation being repeated, the water rises still higher in the suction pipe, till it comes into the barrel. When the plunger *ab* now descends in the barrel, it will drive the water up into the main pipe through the valve *x*.

This pump is said by Dr. Robison to have been invented by Sir Samuel Moreland. The advantage consists in the facility with which the plunger can be repaired, and the accuracy with which it may be made to work. See Desaguliers' *Experimental Philosophy*, vol. i. p. 166.

6. *Description of a Pump without Friction.*

This machine consists of a wooden tube ABCD, either square or cylindrical, having a valve *v* at its lower end. The depth of the water in the pit must be at least equal to the distance of its surface NO from the place of delivery K. A small cistern EADF is placed at the top of the wooden tube, and on a level with K. A tube KHG, with a valve at H, is united to the tube at G. A beam of wood LM, and of at least the same length as the tube, is suspended by a chain from a working beam, and is loaded with weights at L exceeding the weight of the column of water displaced. If this beam now descends by its own weight from the position shown in the figure, the water between M and *v* must rise all round it in the narrow space between it and the tube ABCD, and when the bottom M comes to *v*, the water will have risen to K, in the rising pipe GHK. When the plunger LM is drawn up again to the first position, as in the figure, the water in the tube will sink again, but that in the rising pipe will remain in consequence of the valve H having closed. When the plunger descends a second time, the water will again rise in the tube to K, and will now flow out at K, and the quantity discharged will be equal to the part of the plunger LM below the surface of the pit-water, bating the small quantity between the plunger and the tube, which may be made very small by a good workman.

Dr. Robison observes, that he has seen a machine consisting of two of these pumps, which was made by an untaught labouring man, which had great power. The plungers were suspended from the end of a long beam, the upper surface of which was fixed into a well with a hand-rail on each side. A man stood on one end till one plunger descended to the bottom of its tube, and he then walked quietly to the other end, the declivity being at first about 25°, but gradually growing less as he advanced. In this way he caused the other plunger to descend, and so on alternately. Dr. Robison informs us, that a very feeble old man, whose weight was 110 pounds, raised 7 cubic feet of water 11½ feet high in a minute, and wrought eight or ten hours every day. A stout young man, he adds, weighing nearly 135 pounds, raised 8⅓ cubic feet to the same weight in the same time, and when he was loaded with 30 pounds, he raised 9¼ to the same height, working ten hours a-day without fatigue. See Robison's *Mechanical Philosophy*, vol. ii. p. 671.

7. *Description of Haskins' Quicksilver Pump without Friction.*

Description of Haskins' quicksilver pump without friction. **Plate CCCCLXX.** Fig. 11.

This very ingenious machine was invented by Mr. Haskins and improved by Desaguliers, and has been described in great detail in the *Philosophical Transactions* for 1728, vol. xxxii. p. 5, and also in Dr. Desaguliers' *Experimental Philosophy*, vol. ii. p. 491.

The first experiment which Mr. Haskins made was with an engine which he erected at the house of Dr. Desaguliers about 1720, but in that engine as much mercury was moved every stroke as the water raised, and consequently the expense of the mercury was very great. Dr. Desaguliers however informed him that he might accomplish his object with a very small quantity of mercury, and both Mr. Haskins and a Mr. William Vreem found out the construction represented in Fig. 11.

In this figure *mnop* is a cylindrical iron tube, about six feet long, and open above. Another cylindrical tube, *ab*, close at top, and of a smaller bore, is connected with it at its bottom *on*. From the main pipe A proceeds a third iron cylinder *efgh*, which can move up and down between the other two cylinders without touching either of them. In the main pipe AB there is a valve at *v* and another at *x*, as near as possible to the pipe *efgh*. Let us suppose that the two connected cylinders *mnop* and *ab* are suspended by chains C*m*, C*p*, from the end of a working beam, and let mercury be poured in between *mnop* and *ab* till it rises to about three-fourths of the height *mn*. Let us suppose also, that the lower end of the pipe AB is plunged in the cistern of water, and that the valve *v* is not more than 33 feet above the surface of the water. Let us now suppose that the chains C*p*, C*m*, descend, and along with them the cylinders *ab*, *mnop*, then the air above *a* will be rarefied, the valve *v* will fall, and *x* will rise, and a portion of water will rise in the suction pipe B, and the pressure of the external air acting on the mercury between the tubes *efgh* and *mnop*, will make it descend in that space and rise in the space between *efgh* and the tube *ab*. As mercury is about 13 times heavier than water, it will rise 1 inch in that interval for every 13 inches of rise in the water. If the chains and their attached cylinders are now drawn up, the air which formerly came from the pipe B will be prevented from returning by the valve *x*. The valve *v* will therefore rise, and the air will escape through it at the pipe A. By a repetition of the operation, the water will rise higher and higher in the suction pipe, and the mercury rise higher and higher in the interval between *efgh* and *ab*, till at last the water will flow through *x* and fill the whole apparatus. When this is done the cylinders have descended about 30 inches. If they are now drawn up, the water in *ef* cannot return through the valve *x*, and will therefore be forced up through the valve *v* into the rising pipe A, because in raising the cylinders the force with which they press against the water presses down the mercury between *ab* and *efgh*, and causes it to rise between *efgh* and *mnop*, till the two mercurial columns are nearly on a level. The continued rise of the cylinders causes the mercury to fall still farther between *ab* and *efgh*, and rise still higher in the space between *efgh* and *mnop*. Hence, in order to balance this inequality of the columns of mercury, the water rises through the valve *v* till the height of the water in the pipe A is 13 times the difference of the mercurial columns. When the cylinders are again depressed, more water will rise in the suction pipe, and the rise of the cylinders will drive the water still higher up the pipe A, and the mercury will be higher in the inner than in the outer space. By continuing this action, the water will rise in A till the mercury in the outer space arrives at the top of the cylinder. Dr. Robison remarks, that with the dimensions already mentioned, the machine will raise water about 30 feet in the pipe A above *x*, which will make the whole height above the pit-water 60 feet. The machine requires to be slowly worked.

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* Robison's *System of Mechanical Philosophy*, vol. ii. p. 665.

The following are the dimensions of the three cylinders given by Desaguliers:

	Outer Cylinder.	Middle Cylinder.	Inner Cylinder.
Length,	30 inches.	29.0 inches.	31.2 inches.
Inner diameter,	6.74	6.35	6.03
Thickness,	0.10	0.08	0.13
Outer Diameter,	6.94	6.51	6.29

The quantity of mercury used is 36½ pounds, which rises up to the height of 16 inches between the inner and outer cylinder.

With regard to the effect of this engine, Dr. Desaguliers informs us, that a man raised a hogshead of water 18 feet high in a minute, but he could not continue this exertion above ¼th of an hour. When he wrought, however, so that he could continue 6 or 8 hours a day, he raised a hogshead between 10 and 11 feet in a minute, which Desaguliers considers as the maximum effect produced by a man with the best water engine. Dr. Robison likewise admits that there can be no doubt of the performance of this engine excelling that of any other pump which raises the water to the same height. He considers it as peculiarly applicable in nice experiments for illustrating the theory of hydraulics, as it would give the finest pistons for measuring the pressures of water in pipes.

8. *Description of Dr. Robison's Improvement on Gosset and De la Deuille's Pump without friction.*

Description of Dr. Robison's improvement on Gosset and De la Deuille's pump without friction. PLATE CCCCLXX. Fig. 12.

Dr. Robison describes this improved pump as without friction,—as capable of being constructed in a variety of forms by any common carpenter, and as of great utility in raising a large quantity of water to a small height, or in draining marshes and marle pits, quarries, &c.

In Fig. 12, ABCD is a square trunk, formed of four planks of wood, open at both ends, and having at its upper end a spout B, and a little cistern AB. Near its lower end is a wooden partition, perforated with a hole, in which is a clack valve E. To this wooden partition is nailed a long cylindrical bag, *ffff*, having its upper end fixed to a round board, perforated with a hole containing a valve F. This bag may be made of leather, or of double canvass, a fold of thin leather, or of sheep's skin, being placed between the two folds. The upper end of the bag should be firmly tied with a cord, in a groove turned out of the rim of the board at F. Into the board at F is fixed the fork of the piston rod FG, and the bag is kept distended by a number of wooden hoops or rings of strong wire *ff*, *ff*, and fixed to it at a few inches distance from one another, and kept at the same distance by three or four cords, binding them together, and stretching from the top to the bottom of the bag. The distance of the hoops should be nearly twice the breadth of the rim of the wooden ring to which the upper valve F, and piston rod FG, are attached.

"Now let this trunk," says Dr. Robison, "be immersed in the water. It is evident that if the bag be stretched from the compressed form which its own weight will give it, by drawing up the piston rod, its capacity will be enlarged, the valve F will be shut by its own weight, the air in the bag will be rarefied, and the atmosphere will press the water into the bag. When the rod is thrust down again, the water will come out by the valve F, and fill part of the trunk. A repetition of the operation will have a similar effect; the trunk will be filled, and the water will at last be discharged by the spout.

"Here is a pump without friction, and perfectly tight; for the leather between the folds of canvass renders the bag impervious both to air and water. We know from experiment, that a bag of 6 inches diameter, made of sail cloth No. 3, with a sheep skin between, will bear a column of 15 feet of water, and stand 6 hours work per day for a month, without failure, and that the pump is considerably superior in effect to a common pump of the same dimensions. We must only observe, that the length of the bag must be three times the intended length of the stroke; so that, when the piston rod is in its highest position, the angles or ridges of the bag may be pretty acute. If the bag be more stretched than this, the force which must be exerted by the labourer becomes much greater than the weight of the column of water which he is raising. If the pump be laid aslope in these occasional and hasty drawings, it is necessary to make a guide for the piston rod within the trunk, that the bag may play up and down without rubbing on the sides, which would quickly wear it out.

"The experienced reader will see, that this pump is very like that of Gosset and De la Deuille, described by Belidor, vol. ii. p. 130, and most writers on hydraulics. It would be still more like it, if the bag were on the under side of the partition E, and placed farther down the pump; but we think that our form is greatly preferable in point of strength. When in the other situation, the column of water lifted by the piston tends to *burst* the bag, and that with a great force, as the intelligent reader well knows. But, in the form recommended here, the bag is *compressed*, and the strain on each part may be made much less than that which tends to burst a bag of 6 inches diameter. The nearer the rings are placed to each other, the smaller will the strain be.

"The same bag piston may be employed for a forcing pump, by placing it below the partition, and inverting the valve; and it will then be equally strong, because the resistance in this case too will act by compression."*

A double pump, of a nature similar to that which has now been explained, has been described by Hachette, in his *Traité Elementaire des Machines*, p. 168.

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* Robison's *System of Mechanical Philosophy*, vol. ii. p. 677.

Those who are acquainted with the fine manufacture of water-proof cloth and canvass by Mr. Charles Mackintosh of Glasgow, will see that pumps of the above description, with bag pistons, may be constructed more elegantly and durably by using those water-proof fabrics made by a varnish obtained from the dissolution of caoutchouc, in the naptha procured from coal tar.

9. *Description of an Occasional Pump, of a very simple construction.*

This pump, which is represented in Fig. 13, was suggested to Dr. Robison while describing the construction of a simple valve. In a square wooden trunk ABCD, a piece of oak board EF is exactly fitted to the trunk in an oblique position, and supported by an iron pin, which goes through it at I, one-third of its length from the lower extremity E. The two ends of the board EF are bevilled so as to apply themselves accurately to the sides of the trunk. If a stream of water now rises upwards, it will press with more force on the part IF of the board, than upon the part EI, and consequently it will force it up, and rush through, causing the board to stand nearly parallel to the sides of the trunk. In order to prevent it from rising into the parallel position, its progress must be stopped by a projecting pin. If the stream of water now descends, its pressure on the upper side of the board being again greatest on the part IF, it will be forced back again into its former position, and its two bevilled extremities resting on the opposite sides of the trunk, the passage will be completely shut up. The board EF will therefore perform the office of a very perfect valve, both because it affords the freest passage for the water, and allows very little to get back while it is shutting; for the part IE brings up half as much water as IF allows to go down. The tightness of this valve may be greatly increased by fixing two thin fillets G and H to the sides of the trunk, and covering with leather those parts of the board EF, which come in contact with them.

The valve being thus constructed, a square box, *abcde*, covered on the outside with soft leather, is made to slide, without sticking, along the wooden trunk ABCD, and a piston rod is fixed to a piece of wood *e*, morticed into two of the sides of the box *abcde*, which project upwards like the gable ends of a house. A valve similar to EF is placed in this box, and it becomes a pump of the usual form. Dr. Robison remarks, that, if this pump is immersed so deep in the water that the piston shall also be under water, its performance will be equal to any pump.

10. *Description of Delahire's Double Forcing Pump.*

This pump is represented in Fig. 14, and partakes both of the nature of a forcing and a sucking pump. It consists of the great barrel AB, to which is connected the rising pipe EF, with valves opposite to E and F, and the main pipe CD, with valves opposite to C and D. The piston *b* is of one piece, without any valve, and the piston rod *a b* works in a collar of leather at A. When the piston is depressed to B, the valve F will shut, and the air below the piston will be driven through C up the pipe CD; and, in consequence of the rarefaction of the air above the piston, the valve D will shut, and the water will rise up FE, through the valve D, into the barrel above the piston. When the piston is raised towards A, it will force up the water above it, through the valve D, and up the pipe DC, while water will rise through the pipe HF, and pass through the valve at F, into the barrel below the piston.

11. *Description of a Centrifugal Pump.*

Description of a centrifugal pump. PLATE CCCCLXX. Fig. 15.

In the centrifugal or rotatory pump, the centrifugal force produced by rotation is the immediate agent in raising the water, combined with the pressure of the atmosphere. This machine is represented in Fig. 15, where AB is a vertical tube, moving round gudgeons at A and B, the lowermost of which is in the well from which the water is to be raised. To this vertical tube is connected one or more horizontal arms CD, with an aperture at one or both ends, by which the water is discharged into a circular trough EF, from which it is taken out by the spout at F. The rotatory motion is communicated to the vertical and horizontal pipe, by a handle, or by a band or string passing round the pulley P. The machine is first filled with water, and after it has acquired a sufficient velocity, the water is thrown out by the centrifugal force, and its place supplied by the pressure of the atmosphere necessary to balance the effect of the centrifugal force. When the pump is filled, or is at rest, the valves shown at B shut, and prevent the water from descending, but when the machine is in motion, these valves are of course open.

In 1816, an improvement was made upon the centrifugal machine by M. Jorge. It consisted in making the vertical tube AB immoveable, and in limiting the rotatory motion to the horizontal pipe or pipes. The advantages of this construction are, that the quantity of matter put in motion is diminished, and that the vertical tube may have any form, and any position which local circumstances may require. See *Recueil des Machines de l'Académie*, 1732; and Hachette's *Traité Elementaire des Machines*, p. 136.

12. *Description of Smeaton's Pump for keeping up a constant head of water.*

Description of Smeaton's pump, for keeping up a constant head of water. PLATE CCCCLXX. Fig. 16.

This ingenious pump forms a part of the apparatus by which Mr. Smeaton performed his experiments on the effects of overshot and undershot water wheels; and the object of it was to furnish the wheel with the same quantity of water at each stroke. It is represented in Fig. 16. where ABCD is the reservoir, in which the water is to be kept at a constant height *m n*, so as to flow out uniformly at an aperture in any of its sides. The piston rod *a b* carries a cylinder *a h*, of such a size that the surface *m n* is pressed as much up by the descent of the portion *a f* into the water, as it would descend by following the piston *b* in its descent towards EF. The diameter of the cylinder *a f* must be a little less than that of the pipe CDEF, as a portion of the latter is occupied by the forked rod *h b*, which carries the piston. In consequence of the surface *m n* remaining always at the same height, the efflux of the water at any aperture in the sides of the reservoir ABCD will be uniform.

13. *Description of a Pump with a Double Piston.*

Description of a pump with a double piston. PLATE CCCCLXX. Fig. 17.

Pumps with two pistons have been used principally at sea and in fire-engines, as it is an object in both these cases to apply the power of as many men as possible

Fig. 17.

placed near each other. An excellent pump of this kind is represented complete in Fig. 17, where MN is the standard to which the machinery is fixed, AB the body of the pump, CD the rising pipe from which the water is received, and EF the main through which it is forced. A lever handle H a', moving round a fixed fulcrum f, carries the two piston rods $a' v b'$, $a w b$, to the ends of which are attached the pistons b', b. The rods $v b'$, $w b$, are made to work equably and vertically by means of the wheels v, w moving between vertical guides, so that though the rods $a w$, $a' v$ vary their inclination to a vertical line, the piston rods $v b'$, $w b$ work vertically in the main barrel AB.

When the handle H is at its lowest position, the piston b' is near the top of the barrel, and the piston b near the bottom. There are valves in both the pistons, and its operation is obviously similar to that of a sucking pump, the power of it being doubled by the use of two pistons.

In a pump of this kind, described by M. Hachette, the piston rod of the lower piston passes through a collar of leathers in the upper piston, the piston rod being in both placed a little to one side of the centre of the piston. See *Traité Elementaire des Machines*, p. 153. This contrivance is the same with that used by M. Noble, in the hand pump he has made for the navy.

14. *Description of a Three-Barrelled Pump.*

Description of a three-barrelled pump. Fig. 18.

The object of a three-barrelled pump is to keep up a continued current of water by the action of three pistons, one of which is at the bottom of its working barrel, while the second is in the middle of its barrel, and the third, at the top of its barrel, as shown in Fig. 18. In each of the three pumps, which are similar to that shown in Fig. 5, AB is the working barrel, $a b$ the piston rod at the valves, and c the circular orifice or section of the pipe (above D, Fig. 5) through which the water is forced. The rising pipe from which the water is raised is shown at EF, and $m n$ is the suction chamber common to all the three valves.

Pumps of this kind were used by Mr. Smeaton, in the numerous water engines which he erected at London Bridge, Sheffield, and other places which required to be supplied with water. When the pumps are small, the barrels are generally made of brass, but when they are made on a large scale, cast iron is used. Opposite to the aperture c of each barrel, there is a projecting neck or short pipe, covered at the end by a door, through which a workman can get access, for the purpose of repairing the valves. The valves used by Mr. Smeaton were of iron, and shut down upon hinges like a door, being covered with leather on the lower side. The centre pin of the hinge was placed back from the hole which the valve covers; and it was also raised above the surface of the under side of the valve, so that the valve opens in some degree on that side where the hinge is, as well as on the other side. Hence obstructions are less liable to be detained in the valve, and have less power to break its hinge. The hinge is fastened to the body of the pump by a screw passing through the metal into the end of the hinge. The piston or forcer b of each barrel consists of three metallic plates, secured to the rod $a b$. The middle plate, which is turned as true as possible, is accurately fitted to the barrel, and the upper and lower plates are somewhat smaller. Two round pieces of leather, larger than the barrel, are placed above and below the middle plate, and are held fast between it and the upper and lower plates. When these pieces of leather are forced into the barrels, they bend the one up and the other down, round the upper and under plates, so as to form two leather cups, which fit the barrel in the nicest manner, and will not permit any water to pass between them. When the piston b of the first barrel is raised, a vacuum is produced below it, and the pressure of the atmosphere forces the water up through the valve d. The descent of the same piston forces open the valve in the pipe at c, and drives the water up that pipe. While this barrel is forcing up the water through c, the next barrel is sucking it up during the ascent of its piston, while the third keeps up the action in the interval when the change of motion takes place between the two. If the pistons are properly worked, by means of well-adjusted cranks, they will furnish a very constant stream of water.

15. *Description of Mr. Smeaton's Hand-Pump for Ships.*

This pump was invented by Mr. Smeaton in 1765, and was intended to remedy a defect in all pumps used at sea. As the common ship's pumps deliver the water on the main deck, about 4, 5, or 6 feet above the surface of the sea, a quantity of power is thus unnecessarily expended. To remedy this evil, Mr. Smeaton employed horizontal wooden trunks, or pipes, which carried off the water through the ship's sides at as low a level as possible. One end of these pipes proceeded from the upright trunk of the pump, and the other was fitted into boxes, or short wooden tubes, let in through the ship's side, and caulked just above the load water line. "These side pipes were closely jointed with the boxes in the ship's side at one end, and at the other end into strong planks, which were bolted against the sides of the pump, in order that the side pipes might be got out and in without disturbing the pump, which was a sucking pump with its bucket worked by a lever or brake upon the deck over the pump. From the top of the pump, a stand pipe was carried up to the main deck, or as high as was thought necessary to prevent the water reverting and running back into the ship, over the top of the pump, when the sea rose above the orifices of the side pipe, or when, from the ship being in distress, they were under her load water line. By this, even when both boxes and pipes were wholly under water, it would no ways interrupt the action of the pump, for whenever the water in the stand-pipe rose above the level of the water without, the pressure of the column in the stand pipe, would cause it to make its way through the side-pipes, so that in this case no level was lost; and though the pump was at rest, no water could revert down the pump; because there were the valves of both bucket and fixed box, or clack, which prevented it. The working barrel was of brass, and very truly bored, the bucket and fixed box being of the same construction as those used in the steam-engines, and the pump rod was made of greater bulk than was necessary, merely for strength, but by way of weight, that, when the brake was lifted up, the pump rod should readily descend by its own weight. The brake of the pump had a branch fixed on, rather obliquely at each side, so as to form three handles, for four men to work at once; they stood one on each side the middle stem of the brake, and one on the outside of each of the branches; and every quarter of an hour they could relieve themselves by changing hands, which was done by changing places. They were intended to make no more than twenty-five strokes per minute, moving the pump rod 17¼ inches up and down at each stroke, the barrel being a nine-inch bore. This was much better than making shorter strokes, and quicker as they usually do. Their hands moved up and down about four feet six inches, and by working with this stroke at a moderate rate, so as to hold it an hour, four men would in that time deliver 20 tons, at a height of 22 feet. This was upon a supposition of raising the water to the usual height; but when, by the application of the maxims before described, this perpendicular was shortened to 16 or 17 feet, then nearly the same delivery could be made by three men, or proportionably more by four men; that is, as 17 : 22 :: 20 : 26 tons, at 17 feet. The foot of the pump was let through the ship's inner planking or ceiling, betwixt two of the floor timbers, and did not touch the bottom or outside planking within 2½ inches, the lower end being rounded within side like a trumpet mouth, it being a bad plan to have the pump standing upon its lower extremity, with holes bored to let in the water, as it is thus very liable to be choaked by dirt. A plank of the ceiling was made to lift up near the pump's foot, that a man could occasionally get in his arm, to clear away any chips, sand, or dirt, or other matter that should happen to be drawn thither."

16. *Account of Mr. Witty's Improvement on Pumps.*

The disadvantage of raising the water to a higher level than is actually required, seems to have given rise to Mr. Witty's improvement on the pump. Smeaton had already remedied this evil, as we have just seen, in ships' pumps. In distilleries, &c. as well as in ships it is used to force the water to the top of the barrel, and allow it to run off to a lower level. Hence if the water descends from the top of the pump to a place of delivery much below the top of the barrel, the fall of the water through this height is a mechanical force which is entirely wasted, and which might be advantageously employed in raising the water through part of the pump barrel. Mr. Witty avails himself of this power in the following manner: "Instead," says he, "of letting the water or liquid escape from a common pump at the usual place of delivery, I caused it to descend again in a syphon pipe to the lowest level at which it can conveniently be delivered; and as this descent is considerable in ships, brew-houses, &c. a considerable saving of labour is effected in working pumps by a descending column of water or liquor counterbalancing as much in length of the rising column in the pump as the height which it descends in the syphon pipe to the place where it can be delivered."

If we consider the water which in ordinary pumps falls from the top of the barrel to the place of its reception as a mechanical force which is lost, we may avail ourselves of it, by various contrivances for assisting in the work to be performed. In Mr. Witty's contrivance, the men at the pump raise the water to the bottom of the short leg of the syphon, and it is then drawn through the syphon by the water of the larger branch. There are many cases, however, where we may allow the workmen to raise the water to the top of the barrel, and employ the direct force of the descending fluid to work another pump, or perform any other piece of work that may be required.

17. *On Chain Pumps.*

On chain pumps.

In our article HYDRODYNAMICS, Vol. XI. p. 566, we have already given a drawing and description of the chain pump, both as constructed with plugs and with buckets, (see Plate CCCXX. Fig. 6. and Plate CCCXXIV. Fig. 4. and 5.) but as these pumps have been found by long experience to be the most useful at sea, and the least liable to be deranged by accidental causes, we propose to give some farther account of them in this place.

Every English ship of war has four chain pumps, and three hand pumps, which are all fixed in the same well. The old chain pumps were very defective machines previous to the improvements made upon them by Mr. Cole. The sprocket wheels *w*, *w*, Fig. 5. Plate CCCXXIV. had no contrivance to prevent the chain from sliding or jerking back on the surface of the wheel. The links were not only too short, but were ill united, and hence they created much friction in passing round the sprocket wheels, and often broke in situations of a critical kind. In Mr. Cole's improvement, the links are formed of two long plates of iron, with a hole at each end, and fixed together by two bolts, which act as pins for the joints. The buckets or saucers *a*, *b*, *c*, Fig. 4. Plate CCCXXIV. are circular plates of brass with a piece of leather between them; and the sprocket wheels W, W, are formed like the trundles used in mills. They consist of two iron wheels fixed at eight inches distance on the axle, and united by several round iron bolts. The links of the chain have hooks which rest on these bolts, and the chain is thus kept upon the wheel, and prevented from starting back when loaded with a column of water. Mr. Cole has constructed his chain pump so that the chain may be taken up and repaired, or any ballast removed with which it may be choaked. In a comparison of Mr. Cole's pump with one of the old construction, it was found to raise one ton of water in 43½ seconds, with the power of four men, whereas the old pump required *seven* men to raise *one ton* of water in 76 seconds. Mr. Cole's pump was introduced into the navy more than thirty years ago, and the principal alteration it has experienced since that time is the substitution of a curved metal tube in place of the lower sprocket wheel, as the chain passes over it more easily than over a wheel. The cranks are now made to take off, and they are large enough to permit *thirty* men to work at once.

M. Hachette has given in his *Traité des Machines*, Plate ix. a detailed drawing of all the parts of an improved chain pump, to which the reader is referred.

Various experiments have been made on the effect of chain pumps, both vertical and inclined. With a vertical one employed in the construction of the Pont de la Concorde at Paris, *four* men raised 2000 cubic feet, (68.55 cubic metres,) of water to the height of 16½ feet, (5.3 metres,) in one hour, or 363.315 cubic metres of water to the height of one metre, or 90.83 for each man. M. Hachette considers this as too great a mean of the force of four men.

M. Perronet, in building the bridge of Orleans, observed that a vertical chain pump, wrought by twelve men, divided into three relays, raised in 24 hours, to the height of 15 feet, (4.87 metres,) 500 cubic feet, (17.14 cubic metres,) of water. M. Perronet, however, thought that the exertion was in this case extraordinary, and he proposed to reduce the result one-sixth, to make it applicable in ordinary cases. With this reduction the daily work of a man would be 139 cubic metres of water raised a metre.

M. Perronet found that an inclosed chain pump raised in an hour 1998 cubic feet of water to the height of 12 feet or 23976 cubic feet to the height of one foot. He mentions also that two inclined chain pumps, driven by 36 horses, divided into several relays, raised 1177.20 cubic feet of water to the height of 15 feet, or 1765800 cubic feet to the height of one foot; and as a horse is equal to seven men, we have 7 × 36 = 252 men; hence the daily work of one man, as deduced from this experiment, is 7007 cubic feet of water raised one foot. For farther details respecting these experiments, see Hachette's *Traité Elementaire des Machines*.

18. *Description of Trevethick's Temporary Forcer.*

Description of Trevethick's temporary forcer. Fig. 19.

The object of this contrivance, which we owe to Mr. Trevethick, is to produce a constant stream in a common pump, and it consists in attaching to any pump AB, Fig. 19, an additional barrel CD, communicating with the space between the two valves of the pump; and in fixing the two pistons so that they may be wrought at the same time. When the pistons are raised, the space BD below them is filled by the pressure of the atmosphere, while the water above the piston of the pump flows out at E. But when the pistons descend, the valve *v* shuts, and consequently the water driven by the piston *b* being unable to descend through *v*, must ascend through the valve in the piston *a*, and consequently produce a continued discharge from E during the downward stroke of the pistons. See Nicholson's *Journal*, vol. ii. p. 216.

19. *Description of Newsham's Fire Engine.*

Description of Newsham's fire engine. PLATE CCCCLXXI. No. I. Figs. 1, and 2.

As the engines for extinguishing fire are nothing more than pumps for forcing out water in a continued stream, we shall make no apology for describing, in this place, the fire engine of Mr. R. Newsham, and some other contrivances of the same kind.

This engine consists of two pumps, A, B, Fig. 1, 2, which are both sucking and forcing ones, whose pistons are wrought by a double lever LL, fixed on the centre C of two arched heads, upon which the chains wind and unwind, as the pistons *a*, *b*, to which they are attached, rise or fall. When one of the pistons is raised, the water from the reservoir R follows it into the barrel, through the valve *v*. But when the same piston is depressed, the valve *v* shuts, and the water in the barrel is forced through the valve *x* into the air vessel W W, into which a pipe P P′ is inserted, and reaches near to the bottom of the vessel. The same effect is produced by the other piston, with this difference only, that while the one piston is rising and sucking water from the reservoir, the other is forcing into the air vessel the water which it had raised into the barrel by its previous ascent. As soon as the water has risen in the air vessel above the end P′ of the pipe P P′, it is obvious that the air included in the vessel must be compressed by every new quantity of water that is forced into it, and when the water has risen to a considerable height in it, the elasticity or spring of the air reacts powerfully on the surface *m n* of the water in the air-vessel, and compels it to ascend through the pipe P P, through a long flexible leather pipe called the hose, screwed in at P, from the extremity of which it moves with great force, and may be directed, in consequence of the flexibility of the leather pipe, to any part of a house on fire. When more than two men are to work the levers LL, a sort of frame work is attached to the engine, by the cross-bars G H, and treddles are also added, by which the workmen act with their weight in treading. The side trough, into which the water is first poured, is shown at Z. It enters the reservoir R through a copper grating *c d*, leaving any sand, dirt, or stones with which it may be mixed, in the pump. At X Y is seen the handle of a cock E, which may be turned into three different situations. The first is used when, there is water near at hand to work the engine by the sucking pipe S, in which case the water enters at S, and rises through the valve *v*, and there is no communication between the barrels and the reservoir R. In the second position of the cock, there is no communication between the barrels and the end S of the sucking pipe; but the water from the reservoir R enters the cock E sidewise, and turning at right angles through the cock towards *v*, enters the pumps. The third position is that in which there is no communication, either with the sucking pipe S, or with the reservoir R, but only a communication between the reservoir R and the sucking pipe S, which is the position when the engine is done working, to empty the water left in the cavity of the cistern.

The following table shows the law according to which the elasticity of the air will act on the surface of the water in the air vessel:

Height of water in air-vessel WW.		Height of the compressed air.		Ratio of the air's elasticity.		Height to which the water will spout.
$\frac{1}{2}$	-	$\frac{1}{2}$	-	2	-	33
$\frac{2}{3}$	-	$\frac{1}{3}$	-	3	-	66
$\frac{3}{4}$	-	$\frac{1}{4}$	-	4	-	99
$\frac{4}{5}$	-	$\frac{1}{5}$	-	5	-	132
$\frac{5}{6}$	-	$\frac{1}{6}$	-	6	-	165
$\frac{6}{7}$	-	$\frac{1}{7}$	-	7	-	198
$\frac{7}{8}$	-	$\frac{1}{8}$	-	8	-	231
$\frac{8}{9}$	-	$\frac{1}{9}$	-	9	-	269
$\frac{9}{10}$	-	$\frac{1}{10}$	-	10	-	297
$\frac{n-1}{n}$	-	$\frac{x}{n}$	-	n	-	$(n-1)\,33$

For a complete and detailed account of Newsham's fire engine, see Desagulier's *Experimental Philosophy*, vol. ii. p. 505.

20. *Description of another Fire Engine.*

Descrip- tion of anoth fire eng

This fire engine, which is now in use, is constructed on the principle of some of the pumps proposed by Ramelli, and which we shall describe in the next section. It is represented in Fig. 4, and is wrought by the levers LL. The interior mechanism is shown in Fig. 3, where CD is the piston working tight in the cylindrical barrel EFD, and moved by the levers LL. When the piston CD is in the position shown in Fig. 3, the water ascending the main M, rises through the valve *v*, and enters by the opening A into the barrel ED. The motion of the piston CD from D to A then closes the valve *v*, and forces the water between D and E up through the valve *x* into the air vessel at W. When CD quits the side B of the barrel, the water follows it, rushing in through the valve *y*, and the aperture B, and when CD returns again towards B, it forces up this water through the valve *z* into the air vessel, as it cannot return towards M by the valve *y*, which closes on the return of CD towards B.

Fig. 4.

Fig. 3.

In constructing the hose or leathern pipes of fire engines, it was customary to sew them together, and when two hose were connected together the one overlapped the other, and the waterway being thus suddenly contracted at the joints, its velocity was retarded. Messrs. Hancock and Sellers of Philadelphia seem to have been the first who joined hose together by rivetting in place of sewing, and this method has been successfully practised for more than twelve years. Mr. Perkins, however, has made some essential improvements on this method. He recommends that the leathers should be more overlapped, and has invented a method of connecting two hose without contracting the waterway at the joints. These improvements are shown in Fig. 5, 6. The rivets represented in *Fig.* 5. are made of copper, which not only lasts four or five times longer than the best thread, but if the overlap is sufficient, the pressure of the water against the overlap acts as a valve to tighten the seam. As the portion of the hose next the engine has been found to burst most frequently, especially when the water is carried perpendicularly, the first, third, or fourth portions are doubly rivetted, as in Fig. 5, the rest having only a single row of rivets. When a rivet breaks, it is replaced by making an opening in the seam of a sufficient size to allow the hand to replace, not merely the rivet that is broken, but those taken out to form the opening. When the rivets are pressed in the holes, they are swelled by placing them upon a flat bar of iron introduced into the entrance of the hose. The rivet and burr should both be of wrought copper, and not of different materials. Tin rivets, for example, with copper burrs will, in consequence of the galvanic action, destroy the leather in a few months. The method of connecting the hose is shown in Fig. 6, where A is the female part of the swivel joint attached to the hose by the female screw *cc*, and prevented from collapsing by the hoop ring *d* within it. On the outer side of this screw is a groove *bb*, on which the swivel ring *aa* revolves; this ring being fixed to the female connecting screw B, by means of rivetting on the end of it at *f*. The male screw C is attached to another portion of hose in the manner already described. The different pieces of leather that compose the hose are connected by a spiral joining of double rivets. See the *Transactions of the Society of Arts*, vol. xxxviii. p. 102.

For farther information on the subject of fire-engines, see *Phil. Trans.* 1676, vol. xi. p. 679. Reaumur's engine, *Mem. Acad.* Par. 1722; *Machines Approuvées*, tom. i. p. 151. Ublemann's engine, *Mem. Acad.* 1722, and *Mach. Approuv.* tom. iv. 35. Gensanne's engine, *Mach. Approuv.* tom. vii. 95. Thillay's engine, *Mem. Acad.* 1746, Hist. 120. Bonnet's engine, *Mem. Acad.* 1749, Hist. 182. Dearborn's engine, *Mem. Amer. Acad. of Arts*, 1794, vol. i. p. 520. Bramah's engine, *Repertory of Arts*, vol. iii. p. 368. Simpkin's engine, *Repertory of Arts*, vol. vii. p. 301. See also Belidor's *Architect. Hydraul.* vol. ii. p. 186. Emerson's *Mechanics*, p. 275. An account of the history of fire-engines, by Beckmann, will be found in the *Phil. Mag.* vol. xi. p. 238, or in his *Hist. of Inventions*, vol. iv. p. 75.

21. *Description of various Pumps, by Ramelli and others.*

As these different pumps all resemble one another in principle, we shall describe them under the same section. They are represented in Plate CCCCLXXI. Figs. 7, 8, 9, and 10.

In Fig. 7, AB is a lever moving round C as a centre. The end BC works in a box CBF, immersed in the water WW. When AC is pulled to the left, the end BC forces out the water up the pipe E and through the valve *v* into the pipe E*v*, where it is kept by the descent of the valve *v*. The water enters the box by an aperture below B.

Plate CCCCLXXI. No. I. Fig. 8. In Fig. 8 a wheel A, with three spiral wings, B, C, D, revolves round A in the centre, and is immersed in the water WW. When C ascends towards F, the water between C and F is forced up into the pipe HG, and is detained by the descent of the valve *v*, the rod FE rising between the guides or rollers *mn* as *c* advances to F, for the purpose of preventing the water from getting through at F. The next wing D produces the same effect, carrying up the water above its natural level WW to the pipe H.

Fig. 9. In Fig. 9, which is taken from the cabinet of Servier, there are two revolving wheels AB, which work in one another, and are pulled close to the elliptical cistern DC. The water which rises through the pipe E into C is forced by these wheels round the outer teeth up to D, and consequently up the pipe F. Ramelli had previously given a pump of this kind, in which there was only one wheel, with a rod like EF in Fig. 27. See *Nicholson's Journal*, vol. viii. p. 35.

Fig. 10. In Fig. 10 the very same effect is produced by a wheel A, furnished with a number of vanes, *m*, *n*, *d*, which fall down on the circumference of the wheel at the side, and resume their other position by the action of a spring *s* attached to each of them. They will consequently force up the water from D to C.

22. *Description of Brown's Atmospheric Engine, in which a vacuum is effected by burning oil or coal gas within the cylinder.*

Description of Brown's atmospheric engine, in which a vacuum is effected by burning gas in the cylinder.

We have seen a model of a pump in which the air in the barrel was rarefied by burning the shavings of wood at the top of the barrel, an airtight cap being put on when the rarefaction was supposed to be at a maximum. A certain quantity of water was thus raised above the valve at the bottom of the barrel, and the operation was repeated till the water rose to the desired height. Though this expedient might be found useful in cases of exigency, it had not a sufficiently practical character, and we have not heard of its being introduced.

An analogous though totally different principle has been happily applied by Mr. Samuel Brown to create a vacuum in pumping engines, which may be employed both to raise water and drive machinery. The specification of the patent by which Mr. Brown has secured his right to this invention, was enrolled only in June 1824, so that we are not able to speak of this invention on the authority of any actual trial of it on a large scale. The principle, however, of the invention is highly ingenious, and we are disposed to view it as a formidable rival to the steam engine in its best form.

In its general character of an atmospherial engine, Mr. Brown's invention resembles the steam engines of Savery and Newcomen, but the vacuum is effected by burning coal or oil gas within the cylinder, so as to consume the atmospheric air.

Fig. 11. The general appearance of Mr. Brown's engine is represented in Plate CCCCLXXI. No. I. Fig. 11, where *a* and *b* are the two cylinders in which the vacuum is to be produced, *c* and *d* two rising mains leading from the reservoir *i* to the top of the cylinders *a*, *b*. Coal or oil gas is conveyed from a gasometer through the pipes *e* and *f*, the last of which passes into the cylinders, and

Plate CCCCLXXI. No. I. Fig. 11.

terminate in the perforated burners *g*, while the pipe *e* terminates in small openings with sliders *h h*, in the side of the cylinders *a* and *b*, immediately opposite to which are lateral jets, communicating with the burner *g*.

The reservoir *i* is filled with water, which, by passing through the pipe *j* into *k*, raises the float *l*, and by pushing up the rod *m*, will elevate the end *n* of the beam *n z*. The cap *o* will thus be lifted from the cylinder *b*, and the cap *p* brought down upon the cylinder *a*. By opening the stop-cocks, the gas is to be let into the pipes *e* and *f*, and the jets at both ends of the pipe *e*, near *h* and *h*, are to be set fire to. The slider *h* having been lifted by an arm *g*, moved by the ascent of the rod *m*, the flame of the jet *e* instantly communicates with the burner *g*, and causes it to burn within the cylinder. In the upper part of the apparatus, there is placed a small cylindrical glass vessel *r*, which is more than half full of mercury. It vibrates on pivots, and as the rod *m* ascends or descends, two small arms *s*, fixed to the rod *m*, strike a pin on the side of the mercury vessel, and thus raise and depress it alternately. The mercury being thus made to flow to the lower side gives motion to certain minor parts of the engine, as will be afterwards explained.

In the position of *r* in the figure the rise of the end *s* of the vessel has by the rod *t* drawn the slider *v* over the mouth of the pipe *j* and closed it, opening at the same time the mouth of the pipe *u*. The water thus flows from *i* into *w* and into *dd*, forcing the float *x* to ascend and lift the rod *y*, which raises the end *z* of the beam, and takes the cap *p* from the cylinder *a*, while it places the cap *o* air-tight on the cylinder *b*.

By this descent of the end *n* of the beam the rod *m* is brought down, which, by the intervention of the arm *y* shuts the slider *h*. As the gas at *g* is now burning within the closed cylinder *b*, the air is consumed during the combustion, and a vacuum produced. The water, therefore, rises, as in a pump in the main *d*, and flows over the top into the cylinder *b*, which is thus nearly filled, the rarefied air escaping through small valves in the top of the cylinder.

During the process, the returning stroke of the beam and the vessel *r* has shifted the slider *v* from the mouth of the pipe *j* upon the mouth of *u*, and by the same operation formerly described, the rod *m* and the end *n* of the beam are raised, by which means the end *z* descends and places the cap *p* on the top of its cylinder, and the gas in the cylinder *a* turns and raises the water into the cylinder in the manner already described.

In order to raise the caps off their respective cylinders *a* and *b*, after a vacuum has been made in them, a small quantity of air is admitted by a slide valve in the air pipe A, which is worked by chains BB attached to the floats *l x*, and by means of the lever *z z* to which the slide above A is attached, the ascent and descent of the floats admits the air alternately into the cylinders *a* and *b* immediately after the water is risen.

The gas is turned off and on by chains C, C, with suspended weights, passing from the ends of the vessel *r* to the stop cock in the gas pipe *f*. The water raised by the engine is retained by the valves at D, D, and it occupies the mains and the outer cases of the cylinders which keeps the interior cool; but the greater portion of the water that is received into the cylinders *a*, *b*, passes off through pipes EE to the trough F, from which it is delivered through a sluice into the buckets of a water wheel GGC, which it drives, and from the axle of which any kind of machinery may be driven. This wheel is unnecessary when the machine is to act merely as a pump.

The inventor remarks, that a piston may be worked on the principle of producing a vacuum beneath it by burning the air in the manner above described; and he proposes that this be done in a distinct vessel, so as to communicate with several cylinders, and consequently to work several pistons at once; the air and vacuum valves being opened and shut by the same means as the induction and eduction valves in steam engines.

Mr. Brown proposes to impel steam boats with this engine, which, he says, will require only a few butts of oil for a long voyage.

Among the advantages of this engine are its small size, which is only one-fifth the weight of a steam engine and boiler of the same power, and its entire freedom from danger. See Dr. Brewster's *Journal of Science*, vol. i. p. 337.

The Rev. Mr. Cecil has described in the *Cambridge Transactions*, vol. i. part ii. an engine in which a vacuum is created by the explosion of a mixture of hydrogen and common air. Mr. Cecil suggested in his paper that the expansive force of the explosion might also be employed.

23. *Description of Mr. Hunter's Self-acting Pump.*

This pump, invented by Mr. Hunter of Thurston, is founded on the same principles as the Hungarian machine, which we have already described in our article Hydrodynamics, Vol. XI. p. 567. The object of it is to raise water above the original reservoir, by the descent of a certain portion of it. It is represented in Plate CCCCLXXI. Fig. 12, where A is the cistern filled by the spring B, C the cistern at which the water is required, and D a water-proof metallic box, twelve inches square, and four inches deep, placed within A, and near the top of it. A pipe F, of half an inch bore, leads from the top of A to the bottom of F, which is a metallic box similar to D. A pipe G of half an inch bore, leads from the top of the box F to the top of D, the upper part of it being above the level of B. Another pipe H, of half an inch bore, leads from the bottom of D to the bottom of C, and is made as long as from R to S. One valve I opening upwards, is placed at the mouth of the pipe H, another K opening upwards at the bottom of D, and a third L opening upwards at the bottom of F. A pipe M conveys the overflowing water of E to a small light pan N, which, when filled with water, presses down one end of a lever O, which opens the valve L. A flat piece of leather at the end of a chain, is suspended from the pan P, and that piece of leather opens a hole at A, when the arm O and pan N are forced down. The hole Q must be of a sufficient size to let the water escape from the pan N, in the same time that D is filling with water through the valve K.

When the vessels D and F are full of air, the water flows from A into E, drives out the air from F, passes through G and D to I, and from E, F, and G, to the level of B. It then flows over at R into the pipe M, fills N, which descending by the weight of the water round the fulcrum *f*, opens the hole Q, and the valve L as formerly described. The vessel F then empties itself at L, is filled with air from D through G, and D is filled with water through K. At the same time N is emptied through Q and returns to its place, allowing L to shut and leaving F and G full of air. The

Pump.

water continues to rush through F, expelling the air from F through G at D, which air again expels the water from D through H up to C, until F and G are filled with water, and O with air, when the machine has returned to the same state as at the commencement of the operation, F and G being filled up to the level of B.

If it is desired to supply a house with water at the level of the middle story, the vessel F may be placed in the kitchen, and C in the bed-room, and every gallon of water under the kitchen will give nearly a gallon in the bed-room. The pipe F may be supplied with impure or even dirty water; and in that case, the whole of the spring water of B will be doubled to C, instead of half of it being wasted at L; so that the whole of any spring may be raised by forming a dam as in mills, and obtaining a fall for a part of the water equal to the height to which it is required to pump up the spring. The effect will be the same, whether R is on a level with B or not. The water will always rise as high above D, as R is from S. The superiority of this pump arises from its acting with very little friction, and, as a proof of this, it may be mentioned, that Mr. Hunter had a small one which wrought, without being touched, for three months, raising eight hogsheads of water every day.

24. *Description of Different Valves used in Pump Work.*

In considering the best forms which can be given to valves, we must attend to the different purposes which they serve. The first and most obvious requisite of a valve is, that it be tight; the second, that it have sufficient strength to resist the forces to which it is exposed; the third, that it allows the water to rise through it freely; and the fourth, that it does not allow much of the water to flow back while it is in the act of shutting.

1. *Clack Valve.*—This valve, which is the simplest, is represented in Fig. 2. and 3. of Plate CCCCLXX. and has already been described in page 205. In cases where it is difficult to get at the valve to repair it, the valve is often fixed in a box like a piston, having its outer surface a little conical, so as to fit a conical seat made for it in the tube. In this case it has an iron ring, or an iron handle, like that of a basket, which can be seized by a long grappling hook when it is required to be drawn up. When the clack valve is opened, it obviously allows a good deal of water to go back during its shutting. Desaguliers considers the loss as equal to one-half of a cylinder of water, whose height is equal to the diameter of the valve. Dr. Robison, however, considers it as less than this quantity. Clack valves are represented in most of the figures in Plate CCCCLXX.

Butterfly Valve.

2. *Butterfly Valve.*—This valve, which derives its name from its resemblance to the two wings of a butterfly, may consist of either two, three, four, or more valves joined together, so as to form a sort of pyramid, and resembling the compound valves which nature has formed in the hearts of minerals. The hinges of each of the clacks of the pyramidal valves are in the circumference of the tube, and the points of the clacks meet in the apex of the pyramid, being supported by four ribs, which rise up from the scales and unite in the middle. When this kind of valve is used for a piston, the rod of the piston is branched out on four sides, when the clacks are four in number, and the branches pass through the piston box, and are fastened below with screws. The four clacks are supported by these four branches.

Button or tail valve. PLATE CCCCLXXI. No. I. Fig. 13.

3. *Button or Tail Valves.*—This kind of valve is represented in Plate CCCCLXXI. Fig. 13. It consists of a piece of metal turned conical, so as to fit exactly the conical cavity of its box. A tail projecting from its lower end passes through a cross bar in the bottom of the box, and there is a little knob to prevent the valve from rising too high. This valve is extremely strong, and may be made perfectly tight by grinding it into its seat with emery. It has the disadvantage of a small water way. Dr. Robison suggested that the lower surface, instead of being flat, should taper below like a boy's top, to diminish its resistance to the water.

Spherical valve. Fig. 14.

4. *Spherical Valve.*—This valve is represented in Plate CCCCLXXI. Fig. 14. and consists of a sphere of metal, which falls into a spherical cavity. It is prevented from rising too high by the inverted box shown in the figure. It is obvious, from the mere inspection of the figure, that this valve must obstruct the water way too much. Dr. Robison remarks, that the spherical valve must not be too light, otherwise it will be hurried up with the water, much of which may flow back while the sphere is returning to its place.

For a popular account of pumps of different kinds, and for tables to calculate their effects, see Ferguson's *Lectures on Mechanics*, &c. vol. i. edit. 1823. See also the other works quoted in this article.

PURACE, a village of New Granada, situated in an elevated plain of the Andes, about 10,000 feet above the sea. It is inhabited by Indians, and is celebrated for the fine cataracts of the river Pusambia, or Rio Vinagre, the waters of which are loaded with oxide of iron and muriatic and sulphuric acids. M. Humboldt visited this plain in 1801, and has described the scenery, &c. which it presents.

PURBACH, GEORGE. See ASTRONOMY, Vol. II. p. 594, col. 2.

PURBECK, ISLE OF. See DORSETSHIRE, Vol. VIII. p. 52, &c.; and p. 54, col. 2; and p. 55, col. 2.

Purcell. Purpuric Acid.

PURCELL, HENRY. See MUSIC, Vol XV. p. 48.

PURPURIC ACID, is the name of a new acid, recently discovered by that able chemist Dr. Prout. It has long been known to chemists that a fine purple liquid is produced by the action of heat and nitric acid upon lithic acid.* When the excess of nitric acid is neutralised by ammonia, and the whole concentrated by slow evaporation, granular crystals of a dark red colour, and sometimes of a greenish hue, are formed. These crystals are the purpurate of ammonia. In order to obtain the purpuric acid, digest these crystals in a solution of caustic potash till the red colour dis-

* The excrements of the *boa constrictor* consist of pure lithic acid.

appears, and drop the alkaline solution by degrees into sulphuric acid, which unites with the potash, and leaves the purpuric acid in the form of a light yellow, or cream-coloured powder. It is insoluble in alcohol and ether, and very insoluble in water. It has no taste nor smell. The specific gravity is greater than that of water. It is dissolved by the mineral acids when they are concentrated. According to Dr. Prout, its composition is as follows:

Two atoms hydrogen .	0.250	4.54
Two atoms carbon .	1.500	27.27
Two atoms oxygen .	2.000	36.36
One atom azote .	1.750	31.81
		99.98

Purpuric acid may be obtained from lithic acid by chlorine, and with more difficulty from iodine.

The *purpurate of ammonia* crystallizes in quadrangular prisms, of a deep garnet red colour, by transmitted light; but, by reflected light, their two broadest faces appear of a brilliant green, while their other two faces appear of a dull reddish-brown colour. The purpuric acid forms other neutral salts with potash, lime, magnesia, strontian, alumina, and almost all the metals. Dr. Prout considers the salts as anhydrous, and composed of two atoms of acid and one of base. He conceives that the purpuric acid and its compounds may constitute the basis of many animal and vegetable colours. He remarks, that "some of the purpurates, as, for example, that of lime, might be probably used as a paint. They might be also used for dyeing, especially wool and other animal productions." See *Philosophical Transactions for* 1818, p. 420.

PUTNEY, a village of England, in Surrey, is situated on the south bank of the Thames, about four miles from London. The church is a small edifice, with a stone tower at the west end. There is here an excellent wooden bridge over the Thames, erected in 1729, which cost £23,975, and yields a revenue of above £3000 per annum. There is on the common an obelisk, built in 1786, to commemorate Hartley's invention for securing buildings against fire. The population of the parish is 492 houses, and 2881 inhabitants.

PUY, Le, a considerable manufacturing town of France, and the chief place of the department of the Upper Loire. It is situated on the river Borne, on the side of a hill, which is crowned with a large and picturesque conical rock. The town is poor looking and ill built. It has a large cathedral, and a public library and cabinet of natural history on a small scale. The manufactures are, blankets, lace, linen, silk, and stoneware. There is likewise here a foundry for copper vessels. Dyeing is also carried on to a great extent. The chesnut trees thrive here wonderfully, and they furnish a great part of the Lyons chesnuts. Population 15,915.

PUY de Dome, the name of a department of France, in Lower Auvergne. It is bounded on the north by the department of the Allier, on the west by that of the Creuse and the Correze, on the north by those of Cantal and the Upper Loire, and on the east by that of the Loire. It contains about 8450 square kilometers, or 428 square leagues. The district of Limagne, forming the principal part of this department, extends from thirty to thirty-five myriametres along the Allier, and is one of the most fertile districts of France. Paris is supplied with oxen from the fine pasturages of the arrondissement of Thiers. The arrondissement of Issoire is celebrated for its cheese, and produces a great deal of nut oil. The department is watered by the Allier, the Dore, the Sioule, the Couse, the Dolore, and the Veyre. The principal productions of the department are corn, wines, fruits, lint, hemp, brandy, nut oil, cheese, and mineral waters, beside lead, iron, marble, and coal. About 300 tons of iron are obtained annually, and 12,000 tons of coal. The following are the principal towns:

	Population.
Clermont, - - - -	24,478
Riom, - - - - -	13,328
Thiers, - - - -	10,605
Ambert, - - - -	5,926
Issoire, - - - -	5,095

Clermont is the capital of the department. The forests occupy about 96,100 acres, of which two-thirds belong to individuals. The contributions in the year 1803 were 3,656,547 francs. Population 509,444. See Clermont, Vol. VI. p. 680.

PUZZUOLI. See Pozzuoli in this volume.

PYCNITE. See Mineralogy *Index*.

PYRAMIDS, the name given to a series of lofty and stupendous buildings in Egypt, which extend from Cairo to the north, upon a plain about fifty miles long, stretching parallel to the Nile. This plain, which is composed of hard calcareous rock beneath, is about eighty feet above the level of the river.

The three largest pyramids are in the neighbourhood of Ghizé or Djiza, viz. those of Cheops, Cephrenes, and Mycerinus, which are surrounded with many others of a smaller size.

The great pyramid of Cheops has the following dimensions, according to different authors.

Authors.	*Length of Base.*	*Number of Steps.*	*Height.*
Herodotus, . .	800 Greek feet,		800 French feet.
Strabo, . .	600		625
Diodorus, .	700		600
Sandys, . .	300 paces,		
Bellonius, .	324 do.		
Greaves, . .	693 Eng. feet,	207	499 Eng. feet.
La Bruyn, . .	704 Fr. feet,		616 Fr. feet.
Prosper Alpinus,	750 do.		625 do.
Thevenot, .	682	208	520
Niebuhr, . . .	710		440
Chazelles, .	705		498 Eng. feet.
Maillet, .	. .	208	
Pocock, . .	. . .	212	
Belon, . .	. . .	250	
French Engineers,	. .	.	448 Fr. feet.

This pyramid is ascended by an uninterrupted series of steps, diminishing from four, to two and half feet high in approaching the top. The breadth of each step is equal to its height. Upon the top there is a platform thirty-two feet square, consisting of nine large stones, about a ton each, though inferior to some of the other stones, which vary from five to thirty feet long, and from three to four feet high. Here the travellers of all ages and nations have inscribed their names in their respective languages. From this platform Dr. Clarke saw to the south the pyramids of Saccara, and on the east of these, smaller monuments of the same kind nearer to the Nile. He remarked also an appearance of ruins which might be traced the whole way from the pyramids of Djiza to those of Saccara, as if the whole had once constituted one great cemetery. The stones upon this platform, as well as most of the others employed in constructing the decreasing ranges from the base upwards, are of *soft limestone*, a little harder and more compact than what in England is called *clunch*. It is of a grayish white colour, and exhales a fetid odour when broken by a smart blow. These stones are of the same nature as the calcareous rock upon which the pyramids stand, and it is likely that they were quarried out of this rock, although Herodotus says that they were brought from the western side of the Nile. The pyramids are built with common mortar externally, but no appearance of mortar could be discerned in the more perfect masonry of the interior. The faces of this pyramid are directed to the four cardinal points.

This pyramid was explored by our countryman, Mr. Davidson, in 1763. His principal object was to determine the depth of the well C, Plate CCCCLXXI, No. II. Fig. 13. He descended from A to B, where there is a grotto, fifteen feet by five feet wide, and less than six feet high. At C, the passage was closed with sand and rubbish, and he found here a rope ladder that had been used by Mr. Wood sixteen years before, yet in high preservation. The length of AB is twenty-two feet, and of BC 128, which, with the addition of five feet between the first and second shaft, gives 155 feet for the whole. The openings from the entrance H, along HIAG and HID, had been long known; the former leading to the Queen's chamber G, and the latter to the King's chamber F. Mr. Davidson having found a new passage at D, and having crawled through it on his face along the ground, discovered a long, broad, and low room E, immediately above F, but some feet longer than it, though of the same breadth. The covering is composed of 8 stones of beautiful granite.

In 1817 Captain Caviglia explored the pyramid with still more success. With a lamp in his hand, and a rope about his body, he entered the shaft A, and he found that the interior of AC was lined with masonry, and that there was a hollow sound below at C. On another occasion he cleared the entrance at H, to admit more air for his operations, and discovered that the passage HI extended to L for 200 feet, and had the same inclination, the same finish of work, and the same dimensions as HI. He found that the channel IL opened directly on the well C, and was continued twenty-three feet farther to M, where it took a horizontal direction MN, twenty-eight feet long, and terminating in a spacious chamber N, *immediately under* the centre of the pyramid, and 100 feet below the base of S. This chamber, which is sixty feet long, twenty-seven feet broad, and fifteen high, is cut out of the solid rock upon which the pyramid is built. In the centre of the room the ground sinks five feet. Some rude and illegible Roman characters had been marked on the wall by the flame of a candle. From this chamber there extends another low passage to the south for 55 feet, and another to the east for about 40 feet. Captain Caviglia found that the chamber E, which is only 4 feet high, is coated with the finest polished red granite, and that its rough floor is composed of the same granite blocks which form the roof of the room F. In the chamber F a sarcophagus had been found, 6 feet 11 inches long, 13 feet wide, 3 feet 1½ inch high.

In all the pyramids the entrance is in the north front, and the descending passages have an angle of 26° or 27°. This line seems to be nearly directed to the pole star, and the north face of the pyramid to be almost in the plane of the earth's equator. This we believe has never been remarked; and we want only accurate measures to put it beyond a doubt. But if they even deviate two or three degrees, this only shows the rudeness of astronomical knowledge at the time when the pyramids were built, or the rudeness of the methods by which the angles were laid down.

Pyrenees.

Pyramid of Cephrenes.

The second pyramid, that of Cephrenes, is said by Denon to have a base of 655 feet, and to be 398 feet high. The whole is thought to have been covered by stucco of gypsum and flint. Belzoni discovered its entrance in the north front in 1818. Advancing along a narrow passage, 100 feet long, he found the great chamber 46 feet long by 16 wide, and 23 high, cut out of the solid rock. It contained a granite sarcophagus, half sunk in the floor, with many bones, some of which have proved to be those of the cow. An Arabic inscription on the wall proves that it had been opened by the Sultan Ali Mahomet.

Of Mycerinus.

The third pyramid of Mycerinus is 280 feet at the base, and 162 high.

Pyramids of Saccara.

The pyramids of Saccara extend five miles to the north and south of the village of Saccara. Some of them are rounded at the top, and are like hillocks cased with stone, as shown in Plate CCCCLXXI. No. II. Fig. 14. taken from Dr. Clarke's *Travels*. One of them has steps like that of Cheops. The ranges or steps are six in number, each range being twenty-five feet high, and eleven feet wide. The total height is one hundred and fifty feet. There is another built also with steps, which is supposed to be as high as that of Cheops. The stones of these pyramids are much decayed, and they are more crumbling than those of Djiza; and hence they are supposed to be older. One of them is built of unburnt bricks, containing shells, gravel and chopped straw, and is in a very mouldering state. See Pococke's *Description of the East*, vol. ii. Clarke's *Travels*, vol. iii. chap. iv. and v.

PYRENEES, a chain of mountains extending from the Atlantic to the Mediterranean, and forming the boundary between France and Spain. They are 200 miles long, and 100 miles at the greatest width. Near Mont Perdu, the hills are between 12,000 and 15,000 feet high. The height of the line of perpetual congelation is about 10,000. The following are some of the heights of the mountains and the passes.

Mountains.	Height in English Feet.
The Pic D'Ossono,	11,700
The Pîc de Midi,	9,300
Canigou,	9,247
The Pic de Los Reyes,	7,620
Pass of Pineda,	8,248
Pass of Gavarnie,	7,640
Pass of Lavarese,	7,350
Pass of Tourmalet,	7,195

See our article Physical Geography, Vol. XV. p. 485, Spain, and the three following articles.

PYRENEES, Eastern, a department in the south of France, is bounded on the north by the department of the Aude; on the west by the departments of the Arriege, and by the Pyrenees; on the south by the Pyrenees; and on the east by the sea. It contains 4337 square kilometers, and 220 square leagues. The chief productions are corn, wines, brandy, fruits, silk, aloes, honey, soda, wool, millet, flax, and hemp. The several productions are iron, some copper and lead, and a little alum. There are few manufactures here. A great many cattle are exported to Spain. The principal rivers are the Tet, the Tech, and the Gly. The chief towns are

	Population.
Perpignan,	11,100
Ceret,	2,382
Prades,	2,332

Perpignan is the chief place of the department. The forests occupy about 45,000 acres. The contributions in 1803 were 1,810,520 francs, and the population 117,764.

PYRENEES, Lower, a department in the south of France, is bounded on the north by the departments of the Landes and the Gers, on the west by the sea and the Pyrenees, on the south by the Pyrenees, and on the east by the department of the Upper Pyrenees. It contains 8072 square kilometers, or 409 square leagues. The department is mountainous, and the scenery grand and picturesque. Its principal productions are maize, corn, flax, wines, pasturage, chesnuts, wood, brandy, and cattle. The mineral products are iron, copper, lead, coal, salt, marble, granite, and alabaster. Its manufactures consist of woollen, linen, and cotton goods and leather. Its chief exports are wine, brandy, pewter, iron, salt, cattle, salted meat, and wool. The principal rivers are the Adour and the Nive. The chief places of the arrondissemens are,

	Population.
Pau,	8,583
Bayonne,	13,190
Ortez,	6,780
Oleron,	6,738
Mauleon,	1,010

Pau is the capital of the department. The forests occupy about 150,000 acres. The contributions in the year 1803 were 1,523,760 francs. Population 384,030. See Bayonne and Pau.

PYRENEES, Upper, a department in the south of France, is bounded on the north by the department of the Gers; on the west by that of the Lower Pyrenees; on the south by the Pyrenees, and on the east by the department of the Upper Garonne. It occupies 4937 square kilometers, or 250 square leagues. Several of its valleys, such as the Aure, the Barege, the Bastan, the Campan, the Cautorets, and the Gavarnie, stretch into the very heart of the Pyrenees, and exhibit much sublime and romantic scenery. In the valleys and on the sides of the mountains, the productions of the department are corn, maize, wines, figs, brandy; and the minerals are iron, copper, lead and calamine. There are fine mineral springs at Bagneres, Barege, Coutarets, &c. The principal rivers are the Adour and the Gers, beside a number of *gaves* or torrents. The chief places of the arrondisemens are as follows:

	Population.
Tarbes,	6777
Bagneres,	5962
Argellez,	810

Tarbes is the chief place of the department. The forests occupy about 115,000 acres. The contributions in 1803 were 893,637 francs. Population 206,680. See Barege.

PYRENEITE. See Mineralogy, *Index*.

PYRITES. See Mineralogy, *Index*.

PYRMONT, a small town of the north-west of Germany, and capital of a district of the same name. It is situated in a fine valley, and has a number of good houses. The citadel is fortified with a broad ditch, high ramparts, and subterraneous passages and vaults.

This town derives all its importance from its acidulous chalybeate springs, which have long been in great repute. So early as 1556 more than 10,000 strangers had been attracted to Pyrmont by its waters. The gay season commences in the end of June, and in July the place is most crowded and brilliant. Those who wish to be free from the bustle of that season should go in the beginning of June, or not till August. The company drink the waters at six in the morning, breakfast at nine, dine at twelve or one; and after dressing they repair to the great promenade or alley, which is formed of four rows of lofty limes planted in 1688. The alley is 500 feet long and 40 wide. The chateau of the prince of Waldeck is very beautiful.

Near the well there is a stone quarry under ground, from some parts of which a sulphurous stream rises to a small height. Animals are suffocated by it. It is a good sudorific to those who stand in it, but with their head sufficiently raised above its influence. Population of the place about 2000. The ingredients of the Pyrmont waters have been already given in our articles Mineral Waters, Vol. XIV. p. 381. See the *Phil. Trans.* No. 448; and the *Miscell. Berolinens.* tom. v. part ii. sect. 4. See *Marcard Beschreibung von Pyrmont.* Leipzig, 1789, 2 vols. and *Pyrmonts Merkwurdigkeiten: eine Skizze fur Reisende und Kurgaste.* Leipzig, 1809, 8vo.

PYROLIGNOUS Acid, or wood vinegar, is the name given to an acid obtained from the destructive distillation of any kind of wood. It has been proved by Fourcroy and Vauquelin, that it is merely the acetic acid, with a little empyreumatic oil and bitumen.

M. Monge first showed that it preserved animal substances from putrefying. It is sufficient to immerse meat or fish for a few seconds in it to preserve it for a long time. Mr. Ramsay of Glasgow, an eminent manufacturer of that acid in the greatest purity, has made many interesting experiments with it, which Dr. Brewster has published in the *Edin. Phil. Journ.* Vol. iii. p. 21. to which we refer the reader. Fish and beef receive a fine flavour from being simply dipped in it; and in warm weather these two substances will keep several days longer if they are merely rubbed over with it by a sponge. In the same Journal, there is a letter to Dr. Brewster from Dr. Stanley of Whitehaven, stating the excellent antiseptic effects upon meat when exposed to a sea voyage, and to a hot climate. See Vol. IV. p. 344.

PYROLITHIC Acid, is the name given to a new acid, obtained from the silvery white plates which sublime from uric acid concretions when distilled in a retort. When a solution of these plates, which are pyrolithate of ammonia, is poured into a solution of subacetate of lead, there falls a pyrolithate of lead, which when well washed with water, is to be decomposed by sulphuretted hydrogen gas. The liquid which swims at the top, yields by evaporation small acicular crystals of pyrolithic acid. It is soluble in four parts of cold water, melts and sublimes in white needles by heat, reddens vegetable blues; is dissolved by boiling alcohol, and by nitric acid without change. It forms neutral salts with lime, barytes, potash, soda, and ammonia. The pyrolithate of lime consists of 91.4 of acid and 8.6 of lime. The pyrolithic acid is composed of oxygen, 44.32; carbon, 28.29; azote, 16.84; and hydrogen, 10.00.

PYROMALIC Acid, the name of a new acid obtained from an acid liquid, which passes over into the receiver, when malic or sorbic acid are distilled in a retort. This liquid yields by evaporation crystals of pyromalic acid.

These crystals are permanent in the air, and melt at 118° of Fahrenheit. They are soluble in strong alcohol, and in twice their weight of water. The solution reddens vegetable blues. This acid forms neutral salts with barytes, potash, and lead.

In the original distillation of the malic or sorbic acid, small white needles appear in the neck of the retort, which are considered by M. Lassaigne as a peculiar acid.

PYROMETER.

The name Pyrometer, from *πυρ*, *fire*, and *μετρον*, *a measure*, is given to those instruments which measure the expansion of solid bodies by heat, and to another class of instruments which measure degrees of heat above those which can be indicated by the mercurial thermometer. This last application of the name is by no means judicious, and, consequently, pyrometers of this kind should be considered as thermometers. We shall, however, proceed to describe these instruments in the order of their invention, and under the two different classes now mentioned.

CHAP. I.—ON PYROMETERS FOR MEASURING THE EXPANSION OF METALLIC BODIES.

I. *Muschenbroek's Pyrometer.*

This machine, which we shall describe nearly in the words of the original inventor, is represented in Plate CCCCLXXI. No. II. Fig. 1, where AAA is a piece of iron turned up perpendicularly at one end, the return being 1$\frac{8}{10}$ inch high. The other end, distant from it $\frac{3}{4}$ inch is also turned up, and is turned back again, so as to make a broad square plate, the side of which is 2 inches. The iron itself is 1 inch wide and $\frac{5}{10}$ thick.

Upon the iron plate stands a brass machine, which is drawn by itself in Fig. 2, where it is represented larger, and seen from another side, the better to discover its parts, which are marked with the same letters as in Fig. 1. This is fixed to the iron by two screws X, X, which are its legs. D is a circular plate of 2$\frac{1}{10}$ inches diameter, divided into 300 equal parts. This divided plate stands upon four pillars E, E, E, E, which join it to the lower brass plate; between these two plates there is a perpendicular steel axis F, which has on its lower part a pinion of 6 leaves, and on its upper a wheel of 60 teeth marked G: There is also another axis I H, supported by a cock from the upper plate, and which axis receives the index I K; having at its lower end a pinion of 6 leaves to take the teeth of the wheel G. The index, by one turn of the pinion H, is carried round to all the divisions. There is besides, a little rack L with teeth, which take the leaves of the pinion F, while the rack slides along under two small cocks P, P, where it is pressed towards the pinion F by two small screws M, M, or drawn from it as there is occasion, that the teeth may neither stick nor be loose. The teeth of the rack are 25 in an inch, and as it moves forward and backward, the pinion F is carried round, and consequently the wheel G, which carries round the pinion H, together with the index I K. Let the rack have run one inch; then F and G will have turned round 4 times and $\frac{1}{6}$; and consequently the pinion H will have gone round $\overline{10 \times 4\frac{1}{6}}$, that is, 41$\frac{2}{3}$ times. Hence 41$\frac{2}{3}$ × 300 = 12,500 parts. Therefore one division corresponds to the 12500th part of an inch.

Fig. 3. represents a square bar, or parallelopiped of metal, upon which the experiment is made, 5$\frac{4}{10}$ inches long, and $\frac{5}{10}$ of an inch thick. One end of it O has a small tail, that it may communicate no sensible degree of heat to the iron A A; it is received in a notch near B, and fixed by the screw C. Its other end N has a hole in it, through which goes the screw Q, which makes it fast to the rack L.

The bar being thus fixed, cannot become longer, without pushing forward the rack L, and moving round the hand I K; so likewise, when it becomes shorter, it must move the contrary way. The weight of the bar is supported by a piece of watch-spring between the square iron and brass plates E A. To apply conveniently the flame of spirits, there is a box of brass, 3$\frac{1}{2}$ inches long, 1$\frac{8}{10}$ inch wide, and $\frac{4}{10}$ inch deep, covered at top with a piece of blue stone, such as will bear the fire. It has a long hole cut through the middle, into which is let in a brass plate T, which has 5 small equidistant holes $\frac{65}{10}$ parts of an inch asunder, and $\frac{7}{100}$ inch in diameter, to transmit the wicks of the lamp. This lamp has 4 feet, which closely take in the iron A between them, that the flame may come against the middle of the bar; but the bottom of the lamp must not touch the iron. The distance between the bottom of the bar and the upper surface of the lamp, must be half an inch, that the cotton wicks which stand up $\frac{3}{10}$ of an inch may give an equal flame. The cotton threads must be fine and even, and 5 of them must make a wick of about $\frac{1}{100}$ of an inch. If the wick is drawn up too high, the flame will be too large. In experiments with highly rectified spirit of wine, there was always an equal quantity put into the lamp.

In the following table, the expansions are marked in parts, of which each is the $\frac{1}{12500}$ part of an inch:

	Iron.	Steel.	Copper.	Brass.	Tin.	Lead.
Expansion by one flame in the middle.	80	85	89	110	153	155
By two flames in the middle, next to one another.	117	123	155	220		274
By two flames 2$\frac{1}{2}$ distant from one another.	109	94	92	141	219	263
By three flames in the middle, next to one another.	142	168	193	275		
By four flames in the middle, next to one another,	211	270	270	361		
By all the five flames.	230	310	310	377		

See *Muschenbrock's Tentamina Academiae dell Cimento* 1731, Part ii. p. 12.; and Desagulier's *Nat. Phil.* Vol. i. p. 439. Edit. third.

2. *Desaguliers' Improvement on Muschenbroek's Pyrometer.*

Desaguliers' improved pyrometer. PLATE CCCCLXXI. No. II. Fig. 4.

Dr. Desaguliers made several important improvements on this instrument. In place of square rods of metal, Dr. Desaguliers used cylindrical ones, B N, Fig 4, as they could be made more uniform, by being drawn like wires. Instead of the pinion F, he used a small roller H made of steel, truly tempered, but not polished, and filed on its surface in the direction of its axis, so that it became a small wheel with an infinite number of teeth. The wheel *gg*, on the same axis, has no teeth, but has a groove, to receive a fine watch chain, or a horse's hair, which carries round a roller *i*, having also a small groove. Upon the upper end of the axis of this roller the index *k i n* is fixed. In order that the chain by which *gg* carries *i* may be properly extended, the whole dial plate, and the cock and pinion *i*, can be moved to or from the wheel *gg* by a screw fastened to the upper frame plate. Instead of the rack NL, Plate CCCCLXXI. No. II. Fig. 4.

Dr. Desaguliers substitutes a long thin plate of steel LN, about $\frac{15}{100}$dths of an inch broad, and filed roughly, so as to move the first roller H, by rubbing against it. It is spring-tempered, and is a little convex towards H; but when it is fastened to the rod at N, there is a spring fixed to the lower brass plate, which draws it straight and tight by the end L, in the direction NL. Instead of the cocks there are two pulleys, P, P, placed horizontally, whose broad vertical grooves receive and direct the steel plate or roller LN, that is substituted for the rack. In place of the watch spring to support the bars, Dr. Desaguliers used a small brass roller, four tenths of an inch in diameter, having its axis horizontal. This roller is raised up by a screw Q so as to support any bar of metal at its end N. By means of these alterations, the sticking of the teeth is prevented, and the motion of the index commences at the instant that the heat is applied to the metallic rods. See Desaguliers' *Experimental Philosophy*, vol. i. p. 444.

3. *Description of Mr. Ellicott's Pyrometer.*

Ellicott's pyrometer. Fig. 5.

The pyrometer, as constructed by Mr. Ellicott, is represented in Plate CCCCLXXI. Fig. 5, where AA is a flat plate of brass screwed down to a thick piece of mahogany. Upon the plate is screwed two pieces of brass, two of which B, B support the flat iron bar C, called the *standard bar*. The upper part of the third piece of brass D is a circle, about three inches in diameter, divided into 360 degrees, and within the circle is a moveable plate *d*, divided also into 360 degrees, and a small steel index. The bar of metal E, upon which the experiment is to be made, rests upon the standard bar C. A bar, two inches and a half long, is fixed to an axis, which turns on two pieces of brass screwed to one of the supports B; and to the end of the lever is fastened a chain, or silk line, which, after being coiled round a small cylinder, to which the index on the brass circle D is fastened, passes over a pulley, and has a weight hung to the end of it. Upon the axis which carries the lever is a pulley, one-fourth of an inch in diameter, to which a piece of watch-chain is fastened. The other end of the chain is hooked to a strong spring G, bearing against one end of the metallic bar E. There is another lever H, exactly similar to F, but the chain fastened to the pulley on its axis, is hooked to the standard bar. The line fastened to the end of this lever, after being coiled round a cylinder, to which the moveable plate is fixed, passes over a small pulley, and has a weight hung to the end of it; or the same line, passing under a pulley, to which the weight is hung, has its other end fastened to the lever F, so that one weight will serve for both levers, as in the figure.

When the bar E lengthens by heat, it allows the weight to draw the lever F upwards, by its action on the spring G, and by means of the silk line, the index will be at the same time carried forward in the circle. When the bar E contracts, the index will return back again, and the same motion will be communicated to the standard bar. An elongation of the bar E one-twentieth of an inch corresponds to 360°, or one revolution of the index, and *one* degree to the 7200th part of an inch.

In using this pyrometer, the bar of metal is laid on the standard bar. The heat of a lamp is first applied to the *standard bar* E, and its expansion, as indicated on the moveable plate, is marked. The expansion of the bar E, by the heat communicated to it from the standard bar, is also measured, as marked by the brass circle. The instrument is then allowed to stand till the whole is thoroughly cold, then removing the bar E, and laying another bar of any other metal in its place, heat the standard bar to the same degree of heat as before, which is seen by the moveable plate's marking the same degree of expansion. The index will then show the degree of expansion of the second metal as it did of the first, and in the same way the expansions of different metals by the same degree of heat may be exactly estimated. The results obtained by Mr. Ellicott were as follows, the heat being the same:

Steel.	Iron.	Gold.	Copper.	Brass.	Silver.	Lead.
56	60	73	89	95	103	149

See *Phil. Trans.* 1736, vol. xxxix. p. 297, for the description of this pyrometer, and the same work 1751, vol. xlvii. p. 485, for an account of the experiments.

4. *Description of Graham's Pyrometer.*

That celebrated artist Mr. Graham constructed also a pyrometer for measuring minute alterations in the length of metallic bars, but unfortunately he has left no description of it behind him. Mr. Smeaton saw the instrument itself at the house of Mr. Short, and he mentions that those alterations were determined by advancing the point of a micrometer screw till it sensibly stopped against the end of the bar to be measured. This screw, being small, and very lightly hung, was capable of agreement with the 3500dth part of an inch. See *Phil. Trans.* 1754, vol. xlviii. p. 598.

5. *Description of Smeaton's Pyrometer.*

This instrument, founded on the same general principle as Graham's pyrometer, is represented in Plate CCCCLXXI. No. II. Fig. 6, which exhibits it without the cistern in which it is used. The bar ABCD is the basis of the instrument. It is one, by one and a half inch thick; and is made of brass. It stands edgewise upwards, and one end is continued of the same piece at right angles, to the height of three and a half inches, to be a firm support for the end of the bar under examination, while the other end acts on the middle of a lever of the second kind, whose fulcrum is on the basis ABCD. The motion at the extremity of the lever is therefore double the difference between the expansion of the bar and the basis. The bar EF to be examined lies in two notches, one of which is fixed to the upright standard AB, and the other to the principal lever HI. The end E of the bar EF bears against the point G, a screw of use in examining the micrometer screw. The other end of the bar EF bears against a small spherically protuberant bit of hard metal, fixed at the same height as G in the principal lever HI. An arbor K is fixed in the basis, which receives at each end the points of the screws H, L, on which the lever HL turns as upon a fulcrum. A slender spring O keeps the lever in a bearing state against the bar, and P is a check to prevent the lever from falling forward when the bar is taken out. The top of the lever is furnished with an appendage N called a feeler, in the shape of a T, suspended and moveable up and down on the points of the screws I,M, which, as well as L,H, are so adjusted as to leave the motion free, but without shake. The handle QR of the feeler is moveable in a loose joint at R, so that laying hold of it at Q, the feeler is moved up and down without being affected by the irregular pressure of the hand. The extremity S of the feeler is also furnished with a bit of protuberant hard metal, to render more perfect its contact with the point of the micrometer screw. The divided index plate is shown at V, and W, a knob for the handle. The micrometer screw passes through two solid screwed holes at D and Y. The piece YZ is made a little springy, and endeavours to pull the screw backwards from the hole at D, consequently the micrometer screw is constantly bearing against its threads the same way, and thus renders its motion perfectly steady and gentle. The index X has divisions upon it answering to the turns of the screw. This piece points out the divisions of the plate, as the face of the plate points out the divisions of the index. In using the instrument, lay hold of the knob at Q with one hand, and moving the feeler up and down, with the other move forward the screw I till its point comes in contact with the feeler, then will the plate and index V and X show the number of turns and parts of a turn. In Fig. 7. is represented the instrument when ready for use, and immerged in its cistern of water AB. The cover C of the cistern goes on between the bar EF and the basis BC when the instrument is raised on blocks. The handle D is for taking off the cover when hot; E is the mercurial thermometer; F the cock to let off the water; GH a hollow piece of tin, which supports seven spirit lamps, which are raised higher or lower by the screws I and K in order to give the water in the cistern a proper degree of heat. The following are the measures in Mr. Smeaton's instrument:

	Inches.
From the fulcrum of the lever to the tube,	5.875
From the fulcrum to the place of contact,	2.895
Length of 70 threads of the screw, -	2.455
Divisions in the circumference of the index plate,	.100

From these data it will be found that the value of one division will be the 5876th part of an inch. When the screw is altered one-fourth of one of these divisions, the difference of contact will be very perceptible to the slightest observer; and consequently the 23145th part of an inch will be perceptible in the instrument.

Mr. Smeaton remarks, that the micrometer is best judged of by the hearing, rather than by the sight or feeling; and that by this method, he found it practicable to repeat the same measurement several times without differing from itself above the 20000th part of an inch.

The following are the results obtained by Mr. Smeaton from an increase of heat corresponding to 180° of Fahrenheit, or the difference between freezing and boiling water.

	Ten thousandths of an Inch.
1. White glass Barometer tube, -	100
2. Martial regulus of antimony, -	130
3. Blistered steel, - - -	138
4. Hard steel, - -	147
5. Iron, - - -	161
6. Bismuth, - - -	167
7. Copper hammered, - -	204
8. Copper, 8 parts mixed with tin 1, -	218
9. Cast brass, - -	225
10. Brass 16 parts, tin 1, - -	229
11. Brass wire, - -	232
12. Speculum metal, - -	232
13. Spelter solder, viz. brass 2, zinc 1,	247
14. Fine pewter, - -	274
15. Grain tin, - - -	298
16. Soft soder, lead 2, tin 1, - - -	301
17. Zinc 8 parts, with tin 1, a little hammered,	323
18. Lead, - - -	344
19. Zinc or spelter, - -	353
20. Zinc hammered one-half an inch per foot,	373

These results agree very well with those made by Mr. Ellicott. See the *Phil, Trans.* 1754, vol. xlviii.

6. *Description of Ferguson's Lever and Wheel Pyrometers.*

Ferguson's lever pyrometer.

The lever pyrometer, invented by Mr. Ferguson, is so simple, as scarcely to require a figure for its illustration. Upon a flat piece of mahogany are fixed brass studs, on which the metallic bar is placed. One end of a bar bears against a lever of the second kind, at a point very near its fulcrum. The other end of this lever, which is bent, bears against another lever, and very near its fulcrum; and the other end of this last lever is the index, which has a graduated arch under it. The small expansion of the metallic bar is magnified by the first lever in the proportion of the distances of the point of pressure from its plane, and from its other extremity; and this magnified effect is again magnified by the other lever, so that an expansion of the 400th part of an inch corresponds to a whole inch on the scale. This pyrometer is liable to the objection that the distance of the points of pressure from the fulcrum and extremity of each lever is variable during the experiment. See Ferguson's *Lectures*, v. i. p. 14. Ed. 1824.

Ferguson's wheel and pinion pyrometer.

Mr. Ferguson's wheel pyrometer differs from the lever one in the substitution of wheels and pinions in place of levers. The metallic bar bears against the end of a short bar which advances between rollers. This short bar has fifteen teeth on one side, which act upon the leaves of a pinion of twelve teeth, on the axis of which is fixed a wheel of one hundred teeth, which teeth again take into the leaves of another pinion of ten leaves, on the axis of which is placed another wheel of one hundred teeth, which again take into the leaves of a third pinion of ten leaves, whose axis carries the index. It is evident from a slight calculation, that one degree of the circular scale divided into 360 parts, corresponds to the 45,000th part of an inch. By means of a piece of watch spring connected with the second pinion by a silk thread, the wheels are pulled back again when the bar contracts, and the teeth of the wheels are kept in contact with the leaves of the pinions. See Ferguson's *Lectures*, vol. i. p. 301. Both these pyrometers are more fitted for the exhibition of the principle and effects of a pyrometer in a public lecture, than for taking any nice measures of expansion.

7. *Description of Ramsden's Microscopic Pyrometer.*

Ramsden's microscopic pyrometer.

The pyrometer of Mr. Ramsden, which we propose to describe, derives its name from two microscopes attached to it, by which the expansions are measured. The apparatus consists of a strong deal frame, five feet long, nearly twenty-eight inches broad, and about forty-two inches high. The bar of metal, the expansion of which is to be measured, and which may be even two feet long, is placed in a copper trough or boiler more than five feet in length, and filled with water. Beneath the trough are twelve spirit lamps, whose flames heat the water in the trough to the boiling point, and consequently the metallic bar is raised to the same temperature. Parallel to the copper trough, and at a little distance from it, are placed two other wooden troughs full of water, in each of which is placed a cast iron prismatic bar. At the extremities of the bars, and perpendicular to them, are fixed the two microscopes above mentioned. One of these microscopes has only a simple mark or point in the field of view, but the other is furnished with a wire micrometer, similar to the wire micrometer described under MICROMETER.

Let us now suppose that the temperature of the two cast iron prismatic bars is kept unaltered, which can be easily ascertained by keeping a thermometer in the water of the troughs in which each is placed. Let the first microscope with a *point* in its field be set above one end of the metallic bar to be examined, so that this point or mark is directly coincident with the extremity of the metallic bar, or with a point or mark near its extremity. In like manner, let the second microscope be fixed above the other extremity of the metallic bar, so that its moveable wire is exactly coincident with the other extremity of the bar, or with a point or mark near it. When these adjustments are made, let us suppose that the temperature of the water in the copper trough, and consequently the temperature of the metallic bar itself is exactly 50°. Place the twelve spirit lamps beneath the copper trough, so as to raise the temperature of the water in it, and consequently that of the bar gradually to 150° or any other temperature; and look through the second micrometer microscope. From the instant that the bar begins to experience the expansive action of the heat, the mark at its extremity will be seen to lose its coincidence with the wire of the micrometer, and extend beyond it. At any temperature, therefore, namely, 60°, 70°, 80°, we can measure the expansion that has taken place by observing how many turns and parts of a turn of the micrometer screw are necessary to bring the micrometer wire into coincidence with the slowly moving mark on the expanding bar; and as the value in parts of an inch of each turn of the micrometer screw is accurately known, we obtain a direct measure of the elongation of the bar, free from all the errors of wheels, levers, and pinions. By this instrument, General Roy obtained the expansions of the bodies to which his name is affixed under Expansion, Vol. IX. p. 254, 255. See *Phil. Trans.* 1785, vol. lxxv. p. 462.

8. *On Troughton's Pyrometer.*

Troughton's pyrometer.

In our article Expansion, Vol. IX. p. 254, we have mentioned the micrometer of that able artist, Mr. Troughton, and promised a description of it under the present article. Mr. Troughton constructed this instrument in 1794, on a small scale, for trying pendulums, and we believe that he does not wish any drawing or minute description of it published till he has completed the large instrument which he has long planned, for measuring the expansion of bars ten feet in length. We may mention however, that this pyrometer measures expansion by the indications of a fine level, which is made to deviate from a horizontal position by the direct influence of the elongation of the bar.

9. *Description of Dr. Brewster's Chromatic Pyrometer.*

Dr. Brewster's chromatic pyrometer. Plate CCCCLXXI. No. II. Fig. 8.

In the different instruments that have been described, the actual elongation of the metallic bar is either magnified by levers, or by wheels and pinions, or it is measured directly by a micrometer screw attached to a compound microscope. In the present instrument, however, the elongation of the bar is measured by the number or the intensity of the polarised tints, which it produces by the inflexion of a plate of glass. If AB, Plate CCCCLXXI. Fig. 8. for example, is the metallic bar at a given temperature, whose end A touches the surface of the glass-plate P Q, then, when it expands by heat, the end A will bend the glass plate into a curve, the sagitta of which is equal to the elongation; and by the principles already fully detailed in our article Optics, Vol. XV. p. 606, the polarised tints corresponding to the degree of inflexion of O P, and consequently to the length of the sagitta of curvature in P Q; or the elongation of the bar, will be seen by looking through the edge P Q with a polarising and analysing apparatus. The tints thus produced have an accurate numerical value, and the scale by which they measure the elongation, may be varied by altering the thickness and length of the plate of glass P Q.

There is one form of this instrument which seems to have a peculiar application to the use generally made of pyrometers for horological purposes. Let us suppose that the clock-maker wishes to have the exact length of a bar of zinc, which has the same expansion as a bar of brass of a given length, for the purpose of destroying the effects of the expansion by their opposite action. The ends of the two bars cannot be made to press on opposite sides of the plate of glass without breaking it, but by using these plates, as shown in Fig. 8, where XZ is a plate of glass placed between two plates MN, PQ, which may either be of glass or metal of equal thickness. If AB is the bar of zinc, and CD the bar of brass, whose expansions are to be equalised, each of them will produce the same inflexion in the plates MN, PQ, which, if they are made of glass, will show either equal or unequal tints; or the middle plate XZ will show no tints at all, if the expansions of the metallic bars are equal. If the curvature of one of these plates predominates, the plate XZ will be concave towards that plate, and this concavity, though too minute to be ascertained by the eye, will be rendered obvious by the positive or negative character of the polarised tints on each side of the neutral line.

A pyrometer of another kind has been suggested by Dr. Brewster. The metallic bar AB presses against a piece of metal AC, which has its face AC ground with emery. A small metallic, or glass cylinder D, truly ground into a socket, in which it freely moves, is turned round by the action of the face AC; which is kept against it by a spring. Instead of putting an index and graduated plate upon D, it is connected with the axis of a goniometer, and its angle of rotation measured with great accuracy. The angle thus found will be an exact measure of the arch of rotation of the surface of the cylinder, and consequently of the elongation of the bar.

Chap. II.—ON PYROMETERS FOR MEASURING HIGH DEGREES OF HEAT.

Although the instruments which we propose to describe under this chapter, are only thermometers adapted for measuring degrees of heat far above the indications of the common thermometer, yet as they are in reality different instruments, founded on different principles, and distinguished by a different name, we shall not scruple to introduce them here.

1. *Description of Wedgewood's Pyrometer.*

No. II. Fig. 9.

In our article Chemistry, (Vol. VI. p. 52.) we have already given a general description of this instrument, and of the principles on which it is founded. We have, therefore, only to give a drawing of the gage, and an account of the relation of its scale to the common thermometrical scale of Fahrenheit.

In Plate CCCCLXXI. Fig. 9, which represents the pyrometrical gage, ABCD is a smooth flat plate, and EF and GH two rulers, or flat pieces, a quarter of an inch thick, fixed upon the plate, with the sides that are towards each other made perfectly true; and a little farther distant at one end EG than at the other end FH, so as to include a long converging canal, which is divided on one side into a number of small equal parts. Now, if a body I is so adjusted as to fit exactly at the narrow end FH of the canal, so that its lower side stands exactly at 0°; then, if it is expanded by heat, and applied in that expanded state to the scale, it will no longer fit into the narrow end FH, but will fill a wider part of the scale farther up, and the divisions opposite to the lower side of I, when it fits, will indicate the degree of expansion. In like manner, the degree of contraction will be obtained by the reverse operation. The following Table, given by Mr. Wedgewood, shows the relation between his pyrometer and the thermometer of Fahrenheit.

	Fahrenheit.	Wedgewood.
Extremity of the scale of Wedgewood's Pyrometer, -	32,277	240
Greatest heat of Mr. Wedgewood's great furnace, - -	21,877	160
Cast Iron melts, - -	17,977	130
Greatest heat of a common smith's forge, - - -	17,327	125
Welding heat of Iron. Greatest,	13,427	95
——— Least,	12,777	90
Fine gold melts, - -	5,237	32
Fine silver melts, - -	4,717	28
Swedish copper melts, -	4,587	27
Brass melts, - -	3,807	21
Heat with which Mr. Wedgewood's enamel colours are burnt in, -	1,857	6
Red heat fully visible in day-light,	1,077	0
——— in the dark,	947	1
Mercury boils, - -	600	3.678
Water boils, - -	212	6.658
Vital heat, - -	97	7.542
Water freezes, - -	32	8.042
Proof spirit freezes, - -	0	8.289
The point at which mercury congeals, and consequently the limit of mercurial thermometers, - -	40	8.596

See *Phil. Trans.* 1782, v. lxxii. p. 305. *Id.* 1784, v. lxxiv. p. 358; and *Id.* 1786, v. lxxvi. p. 390.

2. *Description of Guyton's Platina Pyrometer.*

The object of this instrument, which was exhibited to the National Institute in 1803, was, to measure the highest degree of heat in our furnaces. It consists of a rod or plate of Platina, placed horizontally in a groove formed in a cake of hardened white clay. This plate is supported, at one of its extremities, on that part of the mass which terminates the groove, while the other extremity presses against a bent lever, whose longest arm forms an index to a graduated arch, so that the expansion is indicated on the scale by the index. The bar of Platina was an inch and three quarters long, a quarter of an inch wide, and one-thirteenth of an inch thick. The arm of the bent lever, against which the platina bar presses, is one-ninth of an inch; and the arm, at right angles to it, which acts on the index, one inch and eight-tenths, or twenty times as long. The index carries a nonius, which divides each degree into ten parts; hence Guyton calculates that we may measure an expansion of the 5730-th part of the radius. In order to prevent the position of the index from being changed, in removing the instrument from the furnace, a plate of platina is fixed so as to form a spring against its extremity. See the *Annales de Chimie*, No. 138. vol. xlvi. p. 276, and Nicholson's *Philosophical Journal*, vol. vi. p. 89.

3. *Description of Mr. Daniell's Platina Pyrometer.*

Pyrometer. Daniell's platina pyrometer.

The pyrometer of Mr. Wedgewood, ingenious as it is, had nevertheless fallen into disuse, both from the extreme difficulty of procuring pieces of clay of uniform composition, and from its having been found that time has an influence on the contraction of the clay pieces, the longer continuance of a low degree of heat producing the same contraction as a higher degree of heat continued for a shorter time.*

Plate CCCCLXXI. No. II. Fig. 10 and 11.

Mr. Daniell was therefore led to construct a pyrometer free from these defects, and which promises to be of much utility in the arts, as well as in the sciences. It is represented in Plate CCCCLXXI. Fig. 10 and 11; Fig. 10 representing the whole instrument, and Fig. 11 a part of half the real dimensions. The tube *a b c* is made of black lead earthen ware, and the shoulder in its centre is moulded when it is formed. The end *a* of the tube is close, and the end *c*, which is open, is accurately fitted into a ferule of brass *d*, which carries the scale *e f g h*. Within the tube *a b* is a bar of platinum 10.2 inches long, and 0.14 of an inch in diameter, extending from *b* to *a*, where it is fixed by a nut and screw of the same metal on the outside, and a pin or shoulder on the inside. At *b* it is kept in its place by a small perforated plate of platinum through which it passes. A fine platinum wire about 100th of an inch in diameter, proceeds from the end *b* of the platinum wire, and coming out of the tube at *d*, a piece of silk thread attached to it, is coiled twice or thrice round the axis of the wheel *i*, fixed on the back of the scale, and shown in Fig. 11. The thread is then turned back, and attached to the extremity of a slight spring *m n*, which is stretched on the outside of a brass ferule, and fixed by a pin at *n*. By this means the action of the spring keeps the wire in a state of tension. The axis of the wheel is 0.062 of an inch in diameter, and the wheel itself, which is toothed, works in the teeth of another smaller wheel *k*, one third the diameter of the other, and having one third of the number of teeth. An index *l* is fixed to its axis, which passes through the centre of the scale *e f g h*, which is divided into 360 degrees.

When the extremity *a b* of the instrument is put into the fire, the index *l* at first moves backwards 10 or 20 degrees, in consequence of the expansion of the black lead tube, before the heat has reached the platinum bar; but in a short time it moves rapidly forward, and indicates on the scale the degree of expansion experienced by the bar. By various interesting experiments, for which we cannot find room, Mr. Daniell obtained the following results, which we give, along with those of Mr. Wedgewood.

	DANIELL.		WEDGEWOOD.	
	Fahr.	Pyrometer.	Fahr.	Pyrometer.
Fusing point of cast iron,	3477°	497°	17977°	130°
Fusing point of gold,	2590	370	5237	32
Fusing point of copper,	2548	364	4587	27
Fusing point of pure silver,	2233	319	4717	28
Fusing point of brass,	1869	267	3807	21
Heat of a common parlour fire, . . .	1141	163		
Red heat, just visible in daylight, . . .	980	140	1077	
Fusing point of zinc,	648	94		
Mercury boils, . .	644	92	600	3.673
Fusing point of lead,	609	87		
Fusing point of bismuth,	462	66		
Fusing point of tin,	441	63		

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* Mr. Sivright has proposed to substitute pieces of Agalmatelite in place of Wedgewood's clay pieces.

Pyrometer.

The differences between these results are too striking to escape notice, and show how very imperfect is our knowledge of the effects of high temperatures. See the *Quarterly Journal of Science, Literature, and the Arts*, vol. xi. p. 309—320. This instrument is made by Mr. Newman, Lisle Street.

4. *Description of Dr. Ure's Pyrometer.*

Dr. Ure's pyrometer.

This instrument, which Dr. Ure does not mention as having been actually constructed, is described in his *Dictionary of Chemistry*, published in 1821. Art. PYROMETER.

"Since dry air," says Dr. Ure, "augments 3-8ths for 180°, and since its progressive rate of expansion is probably uniform by uniform increments of heat, a pyrometer might easily be constructed on this principle. Form a bulb and tube of platinum, of exactly the same size as a thermometer, and connect with the extremity of the stem, at right angles, a glass tube of uniform calibre, filled with mercury, and terminating below in a recurved bulb, like that of the Italian barometer. Graduate the glass tube into a series of spaces equivalent to 3-8ths of the total volume of the capacity of the platina bulb, with 3-4ths of its stem. The other parts may be supposed to be little influenced by the source of heat. On plunging the bulb and 2-3ds of the stem into a furnace, the depression of the mercury will indicate the degree of heat. As the increment of the column will be very inconsiderable, it will be scarcely worth while to introduce any correction, for the change in the initial volume by barometric variation. Care must be taken to let no mercury into the platina bulb."

5. *Description of Mill's Pyrometer.*

This instrument, proposed by Mr. Nicholas Mill, is represented in Plate CCCCLXXI. Fig. 12. It consists of a metallic bulb and stem AB of platinum, drawn out without any joint. The bulb is hollow, and has its external diameter about half an inch, according to the size of the instrument. The bore of the bulb B, which is perfectly cylindrical, is about the sixteenth of an inch in diameter, and at the further end of this tube is attached, by an air-tight joint, a glass tube C, which is bent in a triangular form. At the extremity of the tube is a bulb of glass D, of the same capacity as the bulb of platinum B, with a funnel-shaped mouth, (for the insertion of the mercury,) which is afterwards hermetically closed. The scale E is attached to the circular glass stem F and is graduated like a thermometer.

When heat is applied to the platinum bulb, it expands the included atmospheric air, the pressure of which, against the mercury, drives it up the glass tube F, to which the scale is fixed; and as the air expands with an increase of heat, so the mercury rises, and indicates on the scale the degree of temperature. In order to protect the platinum bulb, a cylindrical crucible, made of the most refractory clay, is placed over it, and the empty part between filled up with pounded charcoal or sand. This instrument is made by Messrs. Gilberts, and by Mr. Newman, London. See the *Monthly Medico-Chirurgical Review and Chemico-Philosophical Magazine*, vol. i. p. 1. Lond. 1824.

Pyrope, Pyrophorus.

PYROPE. See MINERALOGY, Vol. XIV. p. 551.

PYROPHORUS is the name of an artificial compound, which ignites by exposure to the air. It was first made by Thunberg in 1680, from a mixture of human excrement and alum, but it may be prepared from alum by calcination, with the addition of various inflammable substances.

Three parts of alum are mixed with from two to three parts of honey, flour, or sugar, and this mixture is dried on the fire in a glazed bowl, stirring it all the while with an iron spatula. The mixture at first melts, but gradually swells up and runs into dry lumps, which are pounded and again roasted, till no moisture whatever remains in them, the mass now resembling a blackish powder of charcoal. The above operation may be saved by directly mixing two parts of charcoal powder with five of burnt alum. The powder is now poured into a phial, with a neck about six inches long, and the phial, when three quarters full, is put into a crucible, which is exposed to the red heat of a furnace for about a quarter of an hour, till the black smoke, which at first issues from the mouth of the phial is succeeded by a sulphurous vapour, which commonly takes fire. When the sulphurous flame ceases the phial is closed with a clay stopper; and when the fire is out, the powder is transferred as fast as possible into a dry and strait glass, made warm, and secured with a glass stopper.

A good pyrophorus may be made by calcining a mixture of three parts of alum and one of wheat-flower, in a common phial, till the blue flame disappears, and preserving it in the same phial with a good stopper. By the exposure of the pyrophorus to the air, the sulphuret attracts its moisture, and produces a degree of heat capable of igniting the carbonaceous matter which is mixed with it.

PYROPHYSALITE. See MINERALOGY, Vol. XIV. p. 544.

PYROSMALITE. See MINERALOGY, Vol. XIV. p. 570.

PYROTARTARIC, ACID. This acid, which was formerly confounded with the acetic, was discovered by Mr. Rose. It is formed by filling a retort half full of tartaric acid. The retort being fitted to a tubulated receiver, heat is applied, and gradually raised to redness. Brown pyrotartaric acid is formed in the liquid produced. When these products are filtered through paper previously wetted, and the liquid saturated with carbonate of potash, it must then be evaporated to dryness, redissolved, and filtered through clean moistened paper. When the oily matter has been completely removed by a repetition of this process, the dry salt must then be heated in a glass retort, with dilute sulphuric acid, at a moderate heat. At first acetic acid passes over into the receiver, but near the end of the distillation there is condensed in the vault of the retort a white and foliated sublimate, which is the pyrotartaric acid perfectly pure. It is sour, and reddens the tincture of turnsole. It is highly soluble in water, and is separated in crystals by spontaneous evaporation. It forms pyrotartarates with potash, soda, ammonia, barytes, strontites, and lime. Dr. Thomson ascribes the discovery of this acid to Gehlen, in 1806. See Dr. Ure's *Dictionary of Chemistry*, Art. ACID *Pyrotartaric;* and Thomson's *Chemistry*, edit. 1817, vol. ii. p. 150.

PYROTECHNY.*

This art is properly divisible into two branches, namely, that for military purposes, and that intended solely for show or amusement. The former division is very limited in its objects; the latter is, on the contrary, very extensive. It is our intention to give an account of each, reducing the innumerable varieties of authors under as few simple principles as possible. Like many other arts, the present has been chiefly confined to the workshops of artisans, and has perhaps never been fairly treated of by any one who, to general principles, united practical knowledge. Hence almost all the treatises on this subject are deficient either in knowledge of the details, or in the arrangement: most commonly, however, in both. Hence also it happens that many of the directions are given in such a manner that it is impossible to understand or execute them; and very often they do not produce the promised effects. It is also from this cause that the books of pyrotechny are encumbered with superfluous receipts; compositions adopted without any principle; containing articles that are pernicious or useless; sometimes containing the same substance under different names, or substances utterly incapable of producing the intended results. When we read in such authors of saltpetre and nitre as different substances, or examine a receipt to make a black flame, it may easily be understood that these censures are not misapplied.

Antiquity of Pyrotechny.

The antiquity and origin of this art is lost in the abyss of past ages. Yet we have little doubt that, like printing, the loadstone, and much more of our knowledge that is little suspected, its cradle was in the east. In China, the use of fireworks for amusement has been known from a period beyond all record; and, in India, that of rockets for military purposes is of an antiquity equally obscure. As all pyrotechny depends on the property which nitre possesses of accelerating the combustion of inflammable substances, even when excluded from the air, and as all the compositions used in this art bear an analogy to gunpowder, it is plain that the antiquity of gunpowder is implied in that of pyrotechny. Yet, as far as the details go, there is little reason to doubt that the art of making various fireworks, by the aid of nitre and inflammable substances, is of more ancient date than that of producing gunpowder, as we now know it. The one, in fact, can be done in a certain way, by almost any mixture of combustibles into which nitre enters in a sufficient proportion; whereas, duly to allot the parts, to mix, and to granulate them, requires a degree of foresight, attention, and practice, which was not likely to have occurred for a long time after. To this compound we owe the invention, as well as the use of ordnance; an invention not difficult to derive from some kinds of fireworks, and infinitely more likely to have been produced in this way, than by the often repeated fable of Barthold Schwartz's mortar, whose claims to the invention we shall presently show are absolutely unfounded.

Without thinking it necessary to examine the question respecting gunpowder particularly, which, properly speaking, is itself but a branch of pyrotechny, we shall here attempt to trace backwards to the oldest records which have reached us respecting any compositions of this nature. Here again we are led back to India; and if any doubt is felt in allowing to the Orientals, from a time so remote, an art which only reached us long after, we must recollect that astronomy and algebra were known in India equally long before they were understood in Europe; and that the latter, in particular, is of very recent introduction. In the same manner were the mariner's compass and printing known to the Chinese: and if we are desirous of wondering why the messengers of Justinian, who brought silk from that remote empire into the west, did not also bring gunpowder and fireworks, we must explain why they did not bring that art which was far more likely to have excited the attention of a literary people.

In Grey's *Gunnery*, printed in London in 1731, the following passage is found, deduced from the life of Apollonius Tyaneus, by Philostratus: "These truly wise men dwell between the Hyphasis and the Ganges: their country Alexander never entered; deterred, not by fear of the inhabitants, but, as I suppose, by religious considerations: for had he passed the Hyphasis, he might doubtless have made himself master of the country all round them; but these cities he never could have taken, though he had led a thousand as brave as Achilles, or three thousand such as Ajax, to the assault: for they come not out to the field to fight those who attack them, but these holy men, beloved by the gods, overthrow their enemies with tempests and thunderbolts shot from their walls. It is said that the Egyptian Hercules and Bacchus, when they overran India, invaded this people also, and having prepared warlike engines, attempted to conquer them: they, in the mean time, made no show of resistance, appearing perfectly quiet and secure; but, upon the enemy's near approach, they were repulsed with lightning and thunderbolts hurled on them from above." These people were the Oxydracæ, and the period of Alexander is 355 before the Christian era.

Here then is a record of the very early use of some kind of firework; whether of ordnance, is more doubtful. We should rather be inclined to think that this story alludes to some kind of rocket, which would fulfil the conditions both of lightning and of thunderbolts, though much more likely to frighten than to destroy an enemy.

The defence of Syracuse by Archimedes in 212 A. C. gives rise to a similar suspicion that even the Greeks were acquainted with some species of firework at that time; though we do not go so far as to imagine that this celebrated mathematician was acquainted with ordnance. Vitruvius relates that, by means of one of his engines, he threw large stones on the Roman fleet with a terrible noise; a description which, as far as the noise is concerned, is not applicable to the scorpion, balista, catapulta, or any of the mechanical artillery of the ancients.

But, to pass over this conjecture, the history of the Oxydracæ will render more easy of belief that which is told of the use of gunpowder, and even of ordnance in China, at a very early period; a time no less distant than 85 years after the birth of Christ; an invention which, if admitted, would prove the much earlier knowledge of less difficult kinds of pyrotechny. We admit that there is, however, somewhat of the air of fable in this story; yet, to confirm the probability of the very early knowledge of explosive compounds in the east, we may quote the code of Hindoo laws, in which it is mentioned; while oriental antiquaries suppose that the date of this code reaches backwards to the time of Moses. But to return to the tale respecting China, which is quoted from Robert Norton's work, printed in 1664.

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* The Editor has been indebted for this interesting article to John MacCulloch, M.D. F.R.S. &c. &c.

"Uffano reporteth that the invention and use, as well of ordnance as of gunpowder, was, in the eighty-fifth year of our Lord, made known and practised in the great and ingenious kingdom of China; and that, in the maritime provinces thereof, there yet remain a certain species of ordnance, both of iron and brass, with the memory of their years of founding engraved on them, and the arms of King Vitey, who, he saith, was the inventor; and it well appeareth, also, in ancient and credible histories, that the said king Vitey was a great enchanter and necromancer; who one time being vexed with cruel wars by the Tartarians, conjured an evil spirit that showed him the use of making of guns and powder, the which he put in warlike practice against the realm of Pegu, and in the conquest of the East Indies, and thereby quieted the Tartars; the same being confirmed by certain Portingales, that have travelled and navigated those quarters, and also affirmed by a letter from Captain Artred to the king of Spain, wherein, recounting very dilligently all the particulars of China, said, 'that they long since used both ordnance and powder;' and affirming further, 'that he found ancient ill-shaped pieces, and that those of later foundry are of far better fashion and metal than the ancient were.'" This testimony must stand for what it may seem worth; but it is abundantly plain, that such stories could not have been invented without an adequate cause; and there is no reason to doubt that the whole of these sister arts, depending on the properties of nitre, were known in ancient times, and that they originated from the east.

It is not easy to trace accurately their progress into Europe; but the same difficulty attends the mariner's compass, attributed to a Venetian, but evidently imported through the then ordinary track of Indian commerce. It is not improbable, however, that the arts that depend on gunpowder came to us by the intervention of the Arabians, as we shall shortly show that the first description of a rocket that we have is by an Arabian writer, in 1249. But here we are driven back to examine the long disputed and difficult question of the Greek fire, the first firework of which we read in European history. The whole question, as well respecting the nature as the origin of this invention, is extremely obscure; but on the former, at least, our present knowledge of chemistry enables us to form some more rational conjectures than those who have preceded us.

On the Greek Fire.

On the Greek fire.

This compound is said to have been invented by a Greek called Callinicus, in the reign of Constantine Pogonatus, A.D. 668; though some assert that it was known to Constantine the Great. Callinicus was an architect of Heliopolis; from the proximity of which to the oriental nations, we are the more inclined to suspect that the invention originated there, and was borrowed by the Greek artist. To confirm this notion of ours, we must remark, that naphtha was one of the ingredients; a substance well known to be common in many parts of the ancient Persian kingdom, and in India; arising, in the former, out of the ground in such abundance, in the form of vapour and otherwise, as to be commonly used for cookery, and other domestic purposes, and also to be an object of religious attention to the worshippers of fire. It is more likely, by much, that a burning compound, in which this was an ingredient, should have been invented where the substance abounded, than where it was unknown. We are not inclined, with some authors, to give the honour of this invention to the Arabian chemists; as we consider that the greater part, if not the whole at least, of their early knowledge, came from India. Our opinion on this head is confirmed by a passage in Quintus Curtius, where a compound possessed of these qualities is mentioned. It is not surprising if, when this burning composition, whatever it was, was new and little known, it should have given rise to so many tales; and, as we truly believe, much exaggeration; for we hope by-and-by to show, that it could not possibly have produced all the marvellous effects that have been attributed to it. Had the Mexicans given the history of the Spanish arms, and that no other history of guns and gunpowder had come down to us, it is easy to understand what the consequences must have been. This composition was kept a secret by the order of Constantine; notwithstanding which, it at length became generally known and used by the neighbouring nations, as we find recorded in all the histories of those days. In the wars of the crusades, it was afterwards well known and used; or at least some similar composition, which might possibly have been an invention of the Arabians, then particularly addicted to chemical pursuits.

It appears to us, indeed, that no single invention, or composition of this nature, will fulfil all the conditions of this supposed Greek fire. It is easy enough to conceive how those who felt the effects and the alarm, and knew not the means, should have confounded all these annoying contrivances under one term; or it is possible enough, that they might have given this as a generic term to all offensive fire-works; while their readers, ignorant of the subject, have imagined that the composition was as simple as the name. We shall presently see, by a description of a few of the effects recorded by the writers and eye-witnesses, what probability there is in this supposition.

But, for the present, to return to the date of this invention, there is reason to think that, like the compounds acknowledged to contain nitre, it was of oriental origin. It is reported by the author of the *Esprit des Croisades*, to have been known in China in 917. This, it is true, is 250 years after the time of Constantine Pogonatus; yet as the Chinese have never been known to borrow arts from the Europeans, it is far more likely to have been known to them long before. That, indeed, is a supposition scarcely to be rejected; if, as we have formerly shown, the eastern nations, and the Chinese among the rest, were acquainted with the truly explosive compounds, or with gunpowder. The same reporter says, that it was there known by the name of The Oil of the Cruel Fire, and that it had been introduced by the Kitan Tartars, who had learnt the compositions from the king of Ou. Thus much respecting the history of an invention which has excited so much curiosity and disputation.

With respect to the composition of this combustible, our information is often unintelligible, and generally worthless. Procopius, in his *History of the Goths*, uses the same term as the Chinese, calling it Medea's Oil, as if it had been some infernal composition of that noted sorceress. According to Anna Comnena, it was composed of sulphur, bitumen, and naptha. The use of naptha is mentioned by others. Some, as Quintus Curtius, consider it as formed of turpentine. By others, again, it is said to have been unctuous and viscid; while, from the description of a third set, it must have been a solid substance. All these jarring reports prove one of two things, perhaps both; namely, that the reporters were ignorant of its nature, and named by guess those substances, with the inflammable nature of which they were acquainted; or, as we insinuated before, that different species of military fire were described under a common name.

Let us now try to reconcile its reported effects, and the manner in which it was used, to any of the compositions above named, or to any single invention. The description in the *Speculum Regale*, from a manuscript of the thirteenth century, is among the least intelligible. After enumerating several military engines, it says, "omnium autem quæ enumeravimus armorum et machinarum, præstantissimus est incurvus clypeorum gigas, flammas venenatas eructans." Of this, we must fairly confess, we can make nothing.

The next account which we shall select is from a French Chronicle of 1190; by which it would appear that it was a liquid enclosed in vessels of some kind, "phioles." Here follows the passage itself: "Ainsi qu'il alloit par mer il rencontre une nef de Saraçens que le Soudan Saladin envoioit en Acre pour le secours faire a ceux, qui etoient en la cité, et cele nef avoit grand plant de phioles de voire pleines de feu Gregois." In this liquid state it was said to be used by hand, at sea, or in close action; and that, in sieges, it was thrown by the usual military engines. Now it is abundantly plain, that this is not Anna Comnena's Greek fire; and we shall soon see that it is not Joinville's. What it was, is not easy to conjecture. Supposing it naphtha or petroleum, or any such liquid, it is certain that it could not have been thrown from any machinery in a stream to any distance, as it must have been extinguished in its passage through the air. As little could it have been used by hand to produce any serious effect; or not, at least, without the risk of equally injuring both parties. On the other hand, it could not have been thrown in an inflamed state in these "phioles," or in any other close vessels, as it could not burn without the presence of air. Here we cannot suppose it to have contained nitre; because that salt will not mix with any liquid bitumen in such a manner as to aid its combustion. It is in vain to say that the Arabs or Greeks of that day had chemical substances unknown to us; and as it is impossible to reconcile this description, we must fain give up the point as unintelligible, excepting in as far as we have proved that this was but one of many military fires. It is worth while, however, to quote the opinions of the times respecting it; as it seems to have inspired an unreasonable degree of terror; and if it were indeed such a liquid as we have here supposed, the effects of it could not have been very formidable:

> Ignis hic conficitur tantum per paganos,
> Ignis hic exterminat tantum Christianos,
> Incantatus namque est per illos prophanos:
> Ab hoc perpetuò, Christe, libera nos.

The descriptions which represent it as unctuous and viscid, and as adhering to the objects which it reached, may perhaps be reconciled to a fluid, kept in "phioles;" but they have exactly the same set of difficulties, and we need not therefore dwell on them. We must now remark, however, that the opinion of its being inextinguishable by water could not justly have been applied to any composition of this nature, and not even to Anna Comnena's receipt; as there is no inflammable substance that could have resisted this application, provided it were used in sufficient quantity, unless under the protection of a carcass or tube of some kind; in which case, it must also have contained nitre. That there is here a good deal of imagination or ignorance in the reports, is indeed plain. The Florentine monk who describes the siege of Acre says:

> Pereat ô utinam ignis hujus vena,
> Non enim extinguitur aqua sed arenâ,
> Vixque vinum acidum arctat ejus pœna,
> Et urina stringitur ejus vix habena.

That sand should have extinguished some of these fires, we can understand; but that it should have been put out by vinegar and urine, and not by water, is impossible; as these were not likely to have been procured in sufficient quantity; surely not in such abundance as water; and on no other principle could the one have acted better than the other.

But we shall now pass over all this merely fabulous matter, and examine the description of Joinville, which is much more intelligible, and which, we think, fully proves our supposition that there were different things known by one name, and that the Greek fire used against Louis at Acre was neither the Chinese oil, nor any oil, nor any viscid substance, nor even the composition described by our celebrated female historian. As this writer was an eye-witness, having been present at this famous siege, his account is as worthy of credit, as it is clear and descriptive. We shall also have reason to see that it implies even the use of gunpowder and ordnance; and that these inventions are also carried back to a period which justifies the account of the Arabian author of 1249 quoted by Casiri.

According to this author, the Geeek fire was thrown from the walls of Acre by a machine called a petrary, occasioning such terror among the commanders of St. Louis's army, that Gualtier de Cariel, an experienced and valiant knight, advised his men, as often as it was thrown, to fall prostrate on their elbows and knees, and pray to God, as he alone could deliver them from the danger. And as the king lay in bed, whenever he was informed that this fire was thrown, he used to raise himself up, and lifting his hands, exclaimed, "Good Lord, preserve my people." This petrary only threw it three times in the night, but it was also thrown four times from a cross bow.

Here we have apparently two kinds of artillery; since as it is described to have come from the bottom of the petrary, that can scarcely have been any thing but a piece of ordnance, and probably a mortar of large bore.

To confirm this opinion, it came forward as large as a barrel of verjuice, with a tail of fire issuing from it as big as a great sword; making a noise in its passage like thunder, and seeming like a dragon flying through the air; and, from the great quantity of fire it threw out, giving such a light that one might see in the camp as if it had been day. Now here we are still left to our conjectures as to the exact nature of this fire; as we have no other account of its use at this place than that of Geoffry de Vinesauf, who attended Richard to the crusade, and who describes it as consuming even flint and iron, and as being unextinguishable by water, while it was also attended by a pernicious stench and livid flame.

It appears, on considering this evidence, that we have to choose between a rocket and a carcase. There are difficulties both ways. The fact of being projected from a mortar, if such was the petrary, is in favour of a carcase; as no rocket will bear the explosion of a piece of ordnance, and as indeed it is not necessary. As little would a cross bow be applicable to a rocket; while small carcases, or inflamed balls of a firm texture, might easily be thrown in this manner. The tail of light is compatible with any species of carcase; and if the projectile was a perfect one, would have proceeded from the fuse; but the noise like thunder which attended its passage is not reconcilable to this notion. Thus it might be supposed that it must have been a rocket; an opinion perhaps supported by the early knowledge of this projectile in India, whence the Saracens seem to have derived all their arts, and this among the rest, yet still at variance with the described mode of projection. We do not pretend to overcome this difficulty, and must therefore leave it, and, as we imagine, in a hopeless state. Whatever this formidable fire was, it seems however to have caused more alarm than injury, as rockets are well known to do.

But we have yet one remark to make on Joinville's narrative, and it leads to our opinion respecting the true nature, at least of this particular kind of the Greek fire. If it was a rocket, it assures us that the Arabs were acquainted with the explosive compounds that depend on the properties of nitre. If, on the contrary, it was any species of carcase, or fire-ball, the same is true; as no resinous, bituminous, or other inflammable substances, could thus be projected in a burning state without being extinguished; particularly if confined in any case, which seems implied in the comparison which is made of it to a barrel. Nitre is here absolutely necessary, and that in considerable proportions; and thus only can carcasses be rendered effectual, to wit, by compounding their materials on the same general principles that regulate the composition of gunpowder. The property of resisting water farther justifies this supposition. We need not prolong this part of the discussion, as no farther light can be thrown on the subject; but, to continue the history of this branch of Pyrotechny to as late a period as is necessary, shall mention the last instances of its use in the western parts of Europe.

At the end of the eleventh century, the Eastern Romans used it against the Pisans; at which period the secret of its composition was unknown, not only to the sufferers, but to western Europe. We are farther informed by Pere Daniel, that Philip Augustus brought some from Acre, and used it against the English vessels at the siege of Dieppe. Lastly, when Ypres was besieged by the Bishop of Norwich in 1383, the garrison defended itself with Greek fire. At this time gunpowder and ordnance had become common; and from this period the very term Greek fire fell into disuse, although in France not many years ago, and in our own country in very late times, different empirics and inventors have pretended to have discovered this secret; always, of course, attributing to it the same effects as the careless and credulous Byzantine writers.

On the Earliest Fireworks containing Nitre.

As we can add nothing on this subject from oriental history or tradition, beyond the testimonies which we have already quoted, we shall here take up the first positive evidence that we can find respecting the knowledge of explosive fireworks, in or near to Europe. In these nitre is an indispensible ingredient, whatever may be deemed respecting some of the varieties, at least of the Greek fire; and they may be considered as belonging to the family of gunpowder. The first positive authority that we can find on this subject is the Arabic author already mentioned in 1249, who is translated by Casiri in his *Bibliotheca Arabo-Hispanica.* The passage is as follows: "Serpunt susurrantque scorpiones circumligati ac pulvere nitrato incensi; unde explosi fulgurant atque susurrant. Jam videre erat manganum excussum veluti nubem per aëra extendi, ac tonitrus instar horrendum edere fragorem, ignemque undequaque vomens omnia dirumpere, incendere, in cineres redigere." Here again we are somewhat puzzled to choose between rockets and shells or carcasses. The "serpunt," the susurrant," and the "circumligati," apply but to the description of the former. But the use of the "manganum," from whence our early engine, the mangonel, derived its name, bespeaks a mechanical force which could not have been required for a rocket, and is moreover not very easy of application. We might almost conclude the same from the effects; "omnia dirumpere, incendere, in cineres redigere," applies rather to a shell than a rocket; unless indeed these were contrived like the Congreve rockets, so as to carry a shell with them. At any rate, the use of nitre, and the true nature of the composition, as far as that goes, is unquestionable.

The next authority is decisive respecting the rocket, and it is found in a manuscript quoted by Dutens, from which Roger Bacon is supposed to have derived his knowledge of fireworks. The author's name is Marcus Græcus, and by the title it appears to be a general essay on military pyrotechny. "Incipit liber ignium a Marco Græco perscriptus, cujus virtus et efficacia est ad comburendum hostes, tam in mari quam in terra." The directions for making a rocket are as follow: "Secundus modus, ignis volatilis hoc modo conficitur; ℞. libras duas sulphuris vivi, libras duas carbonis salicis, salis petrosi libras sex; quæ tria subtilissime tereantur in lapide marmorea; postea pulvis ad libitum in tunica reponatur volatili vel tonitrum facientis. Nota, quod tunica ad volandum debet esse gracilis et longa, et prædicto pulvere optimè calcato repleta; tunica vel tonitrum faciens debet esse brevis, grossa, et prædicto pulvere semiplena, et ab utraque parte filo fortissimo bene ligata. Nota, quod in qualibet tunica primum foramen faciendum est, ut tanta imposita accendatur; quæ tenta in extremitatibus fit gracilis, in medio vero lata, et prædicto pulvere repleta. Nota, quæ ad volandum tunica plicaturas ad libitum habere potest, tonitrum vero faciens quam plurimas plicaturas. Nota, quod duplex poteris facere tonitrum, ac duplex volatile instrumentum, vel tunicam subtiliter in tunica includendo." There is here no direction, it is true, for boring a rocket, without which it cannot fly by its own recoil, so that it is possible this firework was a kind of squib, intended to be rendered "volatile" by mechanical means, and not by its own unassisted energy. We think it not unlikely that this is the very fire of Joinville; and the distinction into two parts, the "tunica volatilis," and the "tonitrum faciens," confirms our notion that these ancient projectiles combined the nature of a shell and a rocket together.

The claims of Roger Bacon to the invention of gunpowder, or of any nitrous explosive compounds, however often repeated, are nothing, as may indeed be proved from his own narration; and as he wrote in 1270, or eighty years before Schwartz, the German monk's ill-acquired reputation may be stripped from him without hesitation. The passage in Bacon is as follows: Ex hoc ludicro puerili quod fit in multis mundi partibus, scilicet, ut instrumento facto ad quantitatem pollicis humani, ex violentia salis qui salpetræ vocatur, tam horribilis sonus nascitur." Again, " In ruptura tam modicae rei, scilicet, modici pergameni, quod fortis tonitrum excedere rugitum et corruscationem maximam sui luminis jubar excedit." It is very plain here that Bacon is describing a cracker or squib used by boys, and common in many parts of the world. But we need trace the history of this art no farther. Time, in complicating the movements, in adding new combinations, and in discovering ingredients, before unknown, suppliable to the production of particular effects, has now rendered it an extensive art, which it will nevertheless not be difficult to arrange under a few simple principles.

Of the Ingredients used in Pyrotechnic composition.

These may be divided into the essential, or those by which the fire is produced, and the incidental, by which it is modified. The first of these include nitre, sulphur, charcoal, and certain resinous and oily substances; among the latter, the metals are the chief. We shall examine them in order, with such remarks on their varieties or preparation as are necessary. For want of such discrimination, there is often much difficulty in understanding the popular receipts, while failures are also not unfrequent.

Nitre.—This substance, the soul of all pyrotechny, is often described under two names, viz. saltpetre and sal prunella. This latter is merely fused nitre; and as that salt contains no water of crystallization, there is no difference whatever between it and saltpetre which has been carefully dried. There is, however, an objection to its use, which must be pointed out. In a high heat, nitre is decomposed with the loss of its acid. If, therefore, in the fusion of the sal prunella the heat should accidentally have been raised too high, the consequence is the presence of a portion of the alkali, which, by afterwards absorbing water, renders the compositions into which it enters liable to become damp, and thus to lose their good qualities. To prevent this consequence, so particularly destructive to all the compositions into which iron enters, the saltpetre should not only be thoroughly dried, but carefully purified, that it may be freed from the nitrates and muriates of lime, in particular; salts which attract much moisture. This is to be done only by careful and repeated crystallization; nor should any nitre be used which has not previously been tested with a solution of subcarbonate of potash, and with that of nitrate of mercury. To stand these without having any marks of precipitation, is a proof of that absolute purity which is most essential.

Sulphur.—There are very few compositions in which this is not required. In its usual marketable state, it is always sufficiently pure, and requires no examination; that is to say, when solid or in rolls. Pyrotechnists must be told that there is no difference between cast sulphur and flowers of sulphur; but as this latter is sometimes used from its being already powdered, it is proper they should know that it almost always contains a considerable proportion of sulphuric acid or oil of vitriol. If it is to be used, therefore, it should always be carefully washed; as this ingredient is not only injurious, from its moisture and property of absorbing water, but from its destroying the iron in those compounds into which this highly ornamental ingredient enters. The perishable nature of all the iron fires must be attributed chiefly to this and the preceding species of neglect.

Charcoal.

Charcoal.—In many fireworks this is an indispensible substance; in all cases indeed where iron is used, and where fires are required to be strong, or of a red colour. But it is subject to many variations of quality, not known to pyrotechnists, and which we shall therefore explain. It will be seen that an attention to these is of considerable importance; but we consider it of no moment how the charcoal is burnt, whether in pits or cylinders, provided it be completely deprived of all its volatile parts. All coals that contain much subcarbonate of potash, are objectionable, for the very same reasons above assigned; namely, their property of absorbing water. They are easily examined by washing the powder in hot distilled water, and testing the solution with muriate of lime. That of litmus or turmeric is too delicate; as these will show proportions of alkali that can be productive of no evil consequences. It must next be recollected, that charcoal is required for two distinct purposes, force and ornament. For these two objects, different kinds are required. The greatest force is procured by the coals of soft wood, such as willow and alder; and still more by that of the Rhamnus frangula, or black dogwood. These, therefore, should always be used for sky rockets; in which force is essential, as conducing to high flights; and as far as a rocket composition includes mealed powder, such charcoal will be an ingredient. Those who are desirous of perfection, will use the same woods for the added charcoal. Where the object, on the contrary, is to obtain common red fire, or burning sparks, the charcoal of hard woods is preferable. Still better is it, when, by being long ignited in close vessels, it requires an extreme degree of hardness; as it not only burns brighter, but is thrown out in larger sparks, from its greater power of resisting the force with which the compositions are driven. For the same reason, charcoal for these purposes ought to be coarsely powdered, and the larger parts separated for use; whereas in the case of compounds, where strength alone is wanted, it cannot be too fine. As far as sky rockets are wanted for purposes purely ornamental, they thus require coarse charcoal. Lastly, there are some varieties of charcoal which have the property of producing compound sparks, not unlike those generated by iron; or the original spark bursts after the first explosion, so as to throw out stars of light. The bark of the oak furnishes this kind of coal; which may also be procured from mahogany and other hard woods of hot climates.

Bitumen, Rosin, &c.

Bitumen, Rosin, Tallow, Pitch, Coal.—The former four are used only in military fireworks, and require no particular notice. Coal is recommended in many of the receipts for ornamental works, as producing dark, and even black flames. It is always either useless or pernicious. The flame which it gives, if thoroughly burnt by using nitre enough, is white; and if this is in an under proportion, it yields nothing but smoke, and is even apt to be extinguished.

Camphor.

Camphor.—This is recommended to make a white flame. It is both useless and expensive. The flame which it gives is not perceptible in the burning compound; and a true white flame can be procured only by means of zinc, as we shall hereafter see.

Glass.

Glass.—Pounded glass is recommended in some receipts for producing red sparks. It is not only, however, useless for this purpose, but is a dangerous ingredient in driving, as it is hard enough to set the compositions on fire in the hands of the workmen: while red sparks, or red fire, as it is called, is produced in a more perfect manner by charcoal. It is very necessary, and full time, that many of these absurd processes should be simplified.

Mica.

Mica.—Mica in scales, as it is often found among decomposed granite, is also recommended for producing what is called red and yellow rain; but there are no virtues in yellow or brown mica more than in other colours, as is asserted in the receipt books. The fire which it produces is distinguishable from that of charcoal, but that only at very small distances; and as it is an expensive or difficult substance to procure, it may in almost all cases be safely omitted.

Iron.

Iron.—This metal is the chief ornamental ingredient in pyrotechny, from the property which it has of burning with brilliant sparks when highly heated. It is the soul of Gerbes, and is introduced into all fiery showers. But the effects of different kinds of iron differ much, and it is important to distinguish them for use. It is common to recommend iron filings for most works, particularly for the smaller ones. But malleable iron is far less combustible than steel or cast iron; or the carburetted varieties yield the most sparks, and the finest light. Hence if filings are required, as is the case for the small wheels and other similar works, they should be those of steel at least, as there are not many varieties of cast iron that are easily filed. But in the larger works, it is necessary that the iron should be in particles somewhat larger than it can be procured by means of any file in common use. It is therefore recommended to pound it in a mortar, a thing which is scarcely practicable in any species of iron. It is more easy to procure particles of the requisite bulk by pounding iron turnings; the thickness of which is easily regulated, and which are indeed to be procured abundantly in all iron manufactories. There are two advantages in the use of large particles, as they can longer be preserved from rusting in the case, and as they yield, in burning, much more complicated sparks. Cast iron is also in itself less liable to rust than malleable, and hence it is attended with another advantage. We may add that the best iron for this purpose is what is technically called black pig; very distinguishable, from its dark gray colour, as it is the most highly carburetted variety. White pig has the advantage of being more brittle; but if this be more easy to pound, it is more hard to turn. We may add, that it is possible to diminish the tendency of iron to rust when thus used, by means of lac varnish.

Antimony.

Antimony.—This metal is largely used in fireworks for the production of blue light. It is a mistake to suppose that this can be done by means of sulphur, as when this substance burns rapidly its light is white. Whether the sulphuret of antimony or metallic antimony is used, in both cases it is the burning of the metal which produces the colour. The sulphuret, commonly called antimony, is used for the stars of rockets and common blue fires, but the light which it yields is not so blue or clear as that from the regulus or metallic antimony. This therefore is introduced into the compositions for small ornamental or figured lights, commonly called speckies. In all cases antimony must be powdered; but it need not be extremely fine except for the last purpose.

Orpiment, Red.—This compound of arsenic and sulphur is chiefly used for producing the white colour in signal lights, commonly known by the name of Bengal lights, and used either for military purposes, or in surveying, or lastly in ornamental fires. The light which it gives, though white, and accompanied by much smoke, is not nearly so bright as that produced from zinc; while it is extremely poisonous wherever the operators are exposed to the smoke or burning. For these two reasons its use ought to be exploded altogether.

Zinc.—The use of this beautiful ingredient is scarcely known to any of the pyrotechnists, although as a substance for light, it is far superior to any of the metals. The light which it yields on burning, is as bright as that of the sun and as white, so that the eye can scarcely endure it; and the effect is much increased by the great quantity of silvery smoke caused by its volatile oxide; which reflects the fire, and thus widely increases the sphere of illumination. For signal lights it far exceeds any other substance; a case of an inch in diameter producing a flame that has been seen at seventy miles, and would probably be visible at one hundred. As a military light for discovering the operations of besiegers in their trenches, or for other objects of nocturnal discovery, it has no rival. It is also very applicable for ornamental works, where it serves to vary the colours and effects of light and of sparkling fires. It is used in the shape of filings, and has the advantage of being much more durable than iron when made up.

Copper.—The effect of copper is to give a greenish light; but it is not easy to produce, as the colour is destroyed by too active an inflammation. The nitrate and other salts of this metal will answer this purpose; but they are expensive, and have not been introduced by the firework makers. In the form of filings, it is apt to fail, and the common practice is to use verdigris. Brass filings are recommended, in some books, to produce red sparks; but they are burnt in the explosion, so as to produce only light and smoke; partaking in some degree of the effects of zinc. We may add, that some other modifications of colour may be produced by some others of the metals; but they are expensive, nor are the effects such as to be worth purchasing at a great price.

Nitrate of Strontian.—The effect of this salt, lately introduced into ornamental pyrotechny, is to produce a fine crimson light; nor is it too expensive, considering that it gives a colour so beautiful, and hitherto unknown in this art.

Alcohol.—Spirit of wine is recommended for many compositions, on the futile notion of adding to their inflammability. As it necessarily evaporates, it can produce no such effect. It is also recommended for tempering gunpowder for quick-match, as it does not permit the nitre to crystallize and separate from the other ingredients. This object may however be attained well enough with water, so that it may be considered as an unnecessary expence. Vinegar has also been recommended for the same purposes; but it is of very little use in this point of view, and may also be dispensed with.

As it is of use to know what to avoid as well as to adopt from the various books, which no one is inclined to distrust from the positive manner in which the effects of these substances are spoken of, we shall continue the enumeration of these matters, merely for the purpose of condemning them. We shall, in this manner, save the artists from much labour, expence, and disappointment. With respect to many of them, the uses are absolutely imaginary; and of others, from their palpable absurdity, we can only think that they must have been recommended for the sole purpose of blinding or misleading those who trust to these receipts. We shall have occasion again hereafter, in examining the directions given for making many compositions, to see that they are either impracticable or absurd, or incapable of answering the ends proposed. We can only therefore conclude, either that the authors of these books were entirely ignorant of their subjects, or else that their designs were to maintain secrets which they considered valuable, while they professed to disclose them. To clear out all this rubbish, we consider even more necessary than to describe how the required objects may be attained; nor without such an explanation and examination, indeed, would our readers be able to comprehend why we had varied so much from our predecessors, and to whom credit ought to be given. The assignment of reasons, and the sort of criticism we shall here use, will enable the readers of this article to judge what is right on this subject, from principles. The work of Captain Jones, so called, the chief repository of these impracticable and false receipts, will be among the principal ones to be thus examined, because it is the standard book. The artificers in fireworks, however, as well as ourselves, know pretty well where its faults lie, though still misled by it in many particulars.

Benzoin.—This is recommended as an ingredient in fireworks for the purpose of producing a perfume. It is converted into "flour," as the receipt says, by putting it into an earthen pot, which is to be covered with paper, and then exposed to the fire. This flour is to be returned into the pot, and treated in the same way till it is perfectly white and fine. It is evident that this is a bad method of procuring benzoic acid, which may be obtained much cheaper from the druggists, were it of any use. But in the burning of a firework this substance is not evaporated but destroyed, and consequently it can yield no perfume. An imaginary perfumed oil of Benzoin is also recommended for wet compositions for the same end, when there is no such thing known.

Oil of Spike.—This is an expensive essential oil, all the purposes of which may be served by the oil of turpentine; but in fact none of these essential oils are required for ornamental fireworks. To say the least of them, they are useless.

Sulphur Vivum.—This is the sulphuret of lime which remains after the ordinary purifications of sulphur by melting. It will scarcely burn at all alone, and very imperfectly with nitre; whence it is easy to conjecture what results are to be expected from the numerous compositions into which it enters.

Isinglass.—This is used or recommended to make up the composition for stars into balls; but it is inferior for these purposes to gum, which is therefore here recommended. If too much gum be used, the ready ascension of the stars is impeded. If flour paste be used, the quantity of carbonaceous matter is so great, that they sometimes will not burn at all unless the quantity of charcoal in them is reduced.

Lapis Calaminaris.—This is recommended as producing what is called a "dead fire." On the same principle as clay, it would not only deaden but extinguish any fire, and is, if not injurious, a nugatory ingredient.

Saw dust.—There is no advantage in saw dust which is not to be obtained by charcoal. In the very large cases it may burn in sparks, but not better than that substance does; and in the small ones it is much more likely to extinguish than to maintain the fire. Saw dust.

Amber.—This is one of the useless substances recommended in all the books. It is only calculated to make a bad flame in large cases, and smoke in small ones. It may be safely rescinded from the catalogue of necessaries altogether. Amber.

Clay.—This is a necessary ingredient for the purpose of stopping up various fireworks. It is indispensible in tourbillons and simple wheels, or in all cases of fire that are to burn at the sides instead of the ends. In the cases which are choked, for the purpose of burning the iron more effectually, it is also useful, as it may be rammed down in the vent, and being afterwards perforated, it serves to protect the paper about the choke from burning, and thus preserves the aperture of the same size. In the military iron rockets it is indispensible, to prevent the plate which contains the vent from being destroyed by the torrent of fire; and it ought always to be used in the larger paper rockets, for preserving the dimensions of the hole during the burning. Clay for these purposes ought always to be freed from sand, to prevent all risk of accidents in driving. This the artificer must do for himself, as it is not to be procured thus pure. To effect this, it is introduced into a cask with water, through which plug holes may be made towards the middle and the top. The water and clay being then stirred up, and suffered to stand for a few seconds, the sand subsides to the bottom. If then the muddy water be drawn off in succession through the holes, the finer clays will be suspended in two degrees of tenuity, should that be thought necessary. After it has subsided, and the water is drawn off, it is to be dried and powdered, and thus reserved for use. Clay.

Frankincense, Myrrh.—After the remarks which we made on benzoin, it is almost fruitless to say any thing about these gums, since they are equally useless. It ought, however, to be known to all makers of fireworks, that none of these substances yield a smell unless they smoke, and that at a low heat. Whenever they burn, or when the heat is raised, all smell is destroyed; and there is no species of firework, unless pastilles are included under this form, in which the heat will not burn all these inflammable substances. It is much more amusingly absurd, to find oil of roses and oil of bergamot recommended as ingredients in fireworks. Frankincense. Myrrh.

But we will not pursue this part of our subject further, as our readers may, after these remarks, be enabled to judge without much difficulty respecting the value and uses of such fantastic ingredients. Yet, that our criticisms may not appear unreasonable or unfounded, we subjoin one of Captain Jones's receipts for the composition of what he calls an "odoriferous water balloon."

"Take of saltpetre four ounces, sulphur one ounce, saw dust of juniper half an ounce, saw dust of cypress an ounce, myrrh two drachms, dried rosemary a quarter of an ounce, cortex elaterii half an ounce; all to be moistened with oil of roses." On this we need only remark that it will not burn, to say nothing of the saw dust, of elaterium bark, which has no existence; and of oil of roses, which, for a composition of this weight, would probably cost a few hundred pounds.

Method of Grinding the Ingredients.

Method of grinding the ingredients.

The ingredients which require grinding for fireworks, are saltpetre, sulphur, charcoal, and gunpowder, and each of these requires some notice.

Saltpetre.—It is sometimes recommended in the books of pyrotechny, to pulverize the salt by boiling it down, and stirring it with a stick as it begins to be deposited, in consequence of the evaporation of the water. But it cannot be reduced to powder of sufficient fineness in this manner, so that mechanical means become indispensible. For artificers who work on a large scale, the common cylinder mill, similar to that used by tanners and druggists, is the most expeditious engine; and the cylinder may be made of limestone or of metals, than which none is preferable to cast iron. On a smaller scale, a pestle and mortar may be adopted, and as far as either nitre, sulphur, or charcoal is concerned, both of these may be made of iron. Saltpetre, when produced, can scarcely be passed through a fine sieve, from its adhering together, and therefore the artificer must ascertain its fineness by the feel, or by examining it on a smooth board, on which it is diffused thinly by means of a muller of another board, furnished with a handle. It is very essential to the correct performance of all fireworks, and particularly of sky-rockets and illumination lights, that the saltpetre should be rendered perfectly fine. It is perhaps cheaper to purchase it in that state, when it can be done, from the powder makers, or the grinders of drugs.

Sulphur.—This may be powdered in the same manner, but it admits of being easily sifted through the lawn sieve, which is also required for the charcoal and the mealed powder. The flowers of sulphur are somewhat more expensive, but they require no grinding. The operator must, however, recollect what we mentioned before, that they generally contain acid, or a portion of oil of vitriol. Hence they should be well washed, till the water is tasteless, with water; or, what is better, with a weak alkaline lye first, and with water afterwards.

Charcoal.—The same machinery serves for powdering charcoal, but it requires a different process in sifting. One sieve should be formed of fine lawn, and this finest dust is reserved for compositions that are required to be very accurate, and to give flame rather than sparks. The remainder may be divided by coarser sieves into two qualities or more, according to the fancy of the operator, the largest fragments being reserved for wide cases and big fires, and the smaller for sparks in cascades or wheels, or other works, according to their respective sizes.

Mealed Powder.—It is scarcely safe to grind gunpowder either in a mill or a mortar, unless both of these be made of wood, which would of course require separate machines. If it can be procured, it is much preferable to purchase gunpowder dust from the mills, as it is a mere prejudice among firework makers to suppose that it is not so strong as powder that has been mealed. If, however, this cannot be obtained, the powder must be reduced to this state by the artificer himself. A large mortar of elm, with a pestle of lignum vitæ, will answer this purpose; but there is an inconvenience in this machine, arising from the adhesion of the powder in hard lumps to the bottom of the pestle. It is a better and speedier plan to grind gunpowder by means of an iron shot of 18 or 24 pounds weight, rolled in a large wooden vessel, turned out of some hard wood; either beech or elm. What is called the mealing table is also used for the same purpose. This is, as the name expresses, a table made of smoothed elm, surrounded with a margin, on which the powder is placed. By means of a flat piece of lignum vitæ, or other hard wood, of about six inches square, and furnished with a proper handle, the powder is easily rubbed down. This method is, however, less safe than the preceding; because, if any sand were present, an explosion might easily be produced. In all such cases, it is most important that the tables, or vessels of any kind, should be provided with close covers when not in use; nor should more than a pound be pulverized at a time. All these operations should also be carried on, where there is room, in tents, and not in houses of any kind; as there is, in such situations, much less mischief produced by accidental explosions. Further, no more powder should at any time be at hand than is immediately required; and whatever is finished should be removed without delay. Mealed powder must be carefully sifted from the grains that may remain, by means of the lawn sieve.

On the mixing of Compositions.

This is a circumstance which requires considerable care, as the accurate performance of sky-rockets, and of many other fireworks depends very much upon it. It is impossible to be too particular with regard to these, if any regard is to be had to their accuracy, or if they are intended for signals, or for long flights. In all sorts of illumination and fixed lights, it is even more necessary to be accurate in this respect. In these, the perfection consists in their burning with a steady light, in their all giving out the same size of flame, and in all lasting the same time. Otherwise, as so many are used together, and always disposed in various figures, the effect of a firework is apt to be materially injured or altogether spoiled. There are many other alterations required in this case, but it is the accuracy of mixture which is our present concern.

Supposing that all the ingredients of any composition are determined on, as much should be made at once as is sufficient for all the fires, whatever these may be, that are to be introduced together, or to form any one piece. This is one of the methods of insuring accuracy in time, and correctness in performance. All the compositions that consist of fine materials, such as nitre, sulphur, charcoal, and mealed powder, may be mixed for an indefinite time, because they cannot be overdone. There are different methods of doing this, and the one or the other may be chosen according to the quantity of the materials or the scale on which the operator is to work.

On a large scale, the most speedy and effectual method is by a hopper contrived for this purpose. The composition having been first mixed with the hands as far as it can, is placed in this machine, which is provided with a long and square wooden tube, like a common house gutter, for conducting rain from the roofs. Within this, and in a part of it which is inlayed for that purpose, there is placed an axis, carrying four or more light vanes of tin or of wood, so adapted to the inside of this receptacle or tube, as to fit it easily, and capable of revolving in a vertical direction. The axis communicates with a crank handle outside, which the operator manages. As the mixture begins to descend down the tube, the upper part of which has its opening regulated by a valve, which the same person can contract or enlarge at pleasure, it falls on the vanes of this little mill, which, being turned quickly round, produces an intimate and accurate union of all the parts, and thus it is delivered complete at the lower end of the tube. If it be judged necessary, it may pass through two mills instead of one; and, by means of a band or string, both of these may be set in motion by one hand.

On a smaller scale, the mixture may be made in a cylinder of wood, placed on its end, like an apothecary's mortar, and provided with a well-fitted cover. Through a hole in this, there passes an axle and handle, carrying vanes, placed vertically. The handle may be turned between the hands, or, what is much better, by means of a drill bow, somewhat in the manner practised with chocolate; and, in this manner, a small quantity of mixture can be completed in two or three minutes.

The third method is to introduce the ingredients into a sieve of moderate fineness, provided with a top and bottom cover, so as to be completely enclosed. By agitating this, the ingredients are carried through the sieve into the receptacle below, and thus become accurately mixed.

If now it becomes necessary to mix fine and coarse, or heavy and light ingredients together, a different practice must be adopted. Supposing that antimony, or orpiment, or any weighty substance in fine powder is required, the mixture cannot be effectually performed in either of these ways, to any extent; as the unequal weights of the materials will prevent the composition from being uniform. The proper combustible ingredients, therefore, or the fundamental substances above mentioned, must first be mixed in the requisite proportion, and these additional matters may afterwards be introduced and mixed up with them either by the hand or by a comb with broad teeth. Coarser powdered charcoal, intended to yield sparks, must be managed in a similar manner. Greater care still is required, where metallic filings, and particularly where large particles of iron are to be used; as these are apt to fall through the lighter and finer dust, and thus to become unequally disposed. They should, therefore, first be sifted as equally as possible over the surface of the general or fundamental mixture; after which, with a little care, they may easily be diffused throughout in a regular manner. Owing to their brilliancy and distinctness, the eye is a good judge of the correctness of such mixtures as this.

Of the Moulds, Rammers, and other Utensils required in making Fireworks.

Many of these utensils require to be made with such accuracy, while their forms and materials are not at the same time obvious, that a description of them is absolutely necessary. Without great care in the form and workmanship, and in the choice of substances for many of these tools, the work becomes difficult, or tedious, or impossible; or if it is executed with much unnecessary labour, the performance of the fireworks is incorrect, or sometimes even fails altogether. In describing these objects we shall pass slightly over those which are most easily made, for the purpose of explaining more particularly the nature and construction of those that require greater nicety and more care.

Pyrotechny.

PLATE CCCCLXXII. Fig. 1.

The fundamental utensil, in every sense of the word, required in making fireworks, is a stout block of wood cut across the tree, such as that used by butchers for chopping blocks. More than one of these will of course be wanted, either where there is much work to be done, or many sizes of cases required. It is very convenient to have cavities sunk in those blocks, fitted to contain the bottoms of the moulds, to be afterwards described, by which means they are the more easily kept steady in driving.

The mallet required for driving is made of beech, of a cylindrical form, with a handle prolonged from the axis of the cylinder, having a knob or projection at the end to prevent it from slipping out of the hand. One side of the cylinder should be shaved off for the sake of obtaining a flat surface. Different sizes are also required for different kinds of work; as, with the heavy ones, it would be as impossible to drive small cases, as it would be to drive large cases with light mallets. None, however, need be less than half a pound in weight, and the largest need not exceed six pounds. A series consisting of half a pound, two pounds, four, and six, is quite sufficient.

Such are the materials required for driving. But it is not necessary that all fireworks should be driven by the blows of a mallet, and there are indeed many that will not admit of it. In the smallest classes of serpents and lights, for example, it is more convenient and quicker to drive without the mallet. As a substitute, a metallic ramrod may be adopted; and by making the head sufficiently heavy, as much force as is required may be given with more convenience, while the work also proceeds very quickly. These rammers are best made of gun metal; and it is necessary that they should be very smooth and true. The sizes must be proportioned to those of the *former* and wooden rammers, hereafter to be described.

The former.

The Former. Only two shapes for these are required, namely, spherical and cylindrical. The first, however, are only wanted for the construction of paper shells for mortars: the latter belong to all other fireworks of whatever nature. One, or at most two sizes are sufficient for the spherical formers, and their diameters may be computed for a coehorn, or 5⅝ inch mortar, and for an 8 inch one; as it is not convenient to throw larger shells, on account of the weight and size of the mortar, and as the difference between the royal and coehorn mortars, which is only an inch, renders it unnecessary to adopt both.

As the thickness of the shell for the 8 inch diameter cannot well be less than an inch when completed for firing, six inches will be the diameter of the spherical *former* for this class of mortars. For the coehorn shell ⅝ths of an inch is a sufficient thickness; and the *former* for this size will therefore be 4⅜ inches. These spheres are to be made of beech, and they must be turned very true and polished. A hole is also to be bored in them of an inch in diameter, to receive the stand on which they must be placed when used, and by which also the fuse hole is determined.

The cylindrical formers require to be of every diameter that may be wanted, from the sixth of an inch up to six inches, or even to a foot; as there is no limit to the sizes of fireworks, either for number or dimensions, but the fancy of the operator. The best wood for them, where they are made of wood, is beech; and

Plate CCCCLXXII. Fig. 2.

may be fitted, and about an inch or more in depth, is made in it, so that, when applied, they may both form a solid piece as it were, taking care that the meeting is quite perfect below, and that the upper cylinder stands perpendicular and firm.

It is usual now to have two of these bottoms to each upper cylinder, one of them bearing both a nipple *a*, and a spindle *b*, and the other a nipple *a*, alone. The latter is required for receiving the rocket when the clay wadding is driven down; and it is also convenient for filling the class of cases that do not require boring. The spindle is of course required for all works which, as well as rockets, are to have a cavity. But one bottom may serve for both purposes without difficulty. For this end, a hole is to be bored in the lower cylinder, yet not quite through it, exactly corresponding with that one in the upper piece of the mould. To this must be fitted two metallic cylinders, one with a hemispherical nipple turned on the end, the diameter of which is less than that of the whole bore, and equal to that of the case. The other carries the spindle, which may either be turned in one piece with it, or fitted into the nipple, and then firmly secured. It is so essential that the spindle should be precisely in the line of the rocket's axis, that too much care cannot be taken in making it true and firm, that it may be liable to no accidents.

The diameter of the spindle at the base, as we already noticed for the bores of rockets, is half the interior diameter of the case, and is to be fitted exactly to the choke or vent. This is done, by using a wire of the same dimensions in the subsidiary piece of the *former*, which we ought to have noticed before, and which is inserted into a hole in it, to be used when the case is choked. The length for rockets is within a diameter and a half, or nearly, of that of the composition; but it is more particularly detailed in our tables of rockets. For wheels the diameters of the spindles are the same, but the length need not exceed one or two diameters of the composition, according to the initial velocity which the artist wishes to communicate. Lastly, to keep all these parts firm and steady, a hole must be bored horizontally through the lower cylinder and upper, including the piece which carries the nipple. Fig. 1. To this a wire, *a b*, furnished with a ring, *a*, for withdrawing it, is fitted, which being passed through, and secured on the further side with a forelock if necessary, the mould is ready for use.

In all the smaller works, or even up to two inch diameters, the upper cylinder may thus be made in one piece with a bore. But when port-fires are to be driven, the length of the cases is such as to render it difficult to introduce them, and nearly impossible to withdraw them, in consequence of their extension within the mould. Such moulds, therefore, are best made of two half cylinders well fitted, and held together by driving two or three metal hoops on them. The outsides should be somewhat conical, to admit of their being the more easily taken off when the case is removed, by separating the two parts of the mould. Moulds like these are best made of metal, and as they require neither nipples nor spindles, being burnt without a choke at the ends at which they are driven, they may be altogether sunk within a hole of the block fitted to receive and retain them firmly. Other cases that burn without chokes, such as illumination lights, small serpents, &c. may be treated in the same manner.

Similar divisible moulds are also most convenient for large rockets in cases of whatever nature, as they are both most easy to fit and to remove. These may be made of wood, and secured from splitting by hoops and gun metal in the same manner.

It is not now necessary to be particular with respect to the simpler moulds, since the principles applied to those of port-fires are nearly applicable to all. In the smaller cases, such as serpents, the bores may be made for many different sizes in one block of wood; and if many bores of the same size also are made, much time will be saved. These bores, which constitute the moulds for such cases, must pass quite through the block, as the case cannot be withdrawn as it entered, but must be driven through. A mould thus made requires only to be placed on the block, to which it may be securely fastened by two loops and pins, as well as in many other ways that are too obvious to require description.

On the making of Cases.

This is an important branch of the general matters which concern all fireworks alike. We shall have occasion to mention the sizes and proportions of these for different kinds of fireworks when those are described; but, in the mean time, the same general principles being applicable to all, they will with more brevity be all condensed under this general head.

Materials for Cases.

Paper, wood, and metal are the only materials applicable to the making of cases, and the uses of the two latter are so very limited that a few words will suffice respecting them. For throwing paper shells a metallic mortar is to be preferred, at least in the hands of those artists who are frequently called on for exhibitions, as they are steady, and last for ever. They need not be very strong, as the change of powder which they carry is commonly trifling, and they may be fixed in their beds in a position about two or three degrees off the perpendicular, to permit the shell to fall out of the way of the spectators. A common square box of stout elm, well dove-tailed and nailed, serve the same purpose for discharges of serpents and stars. We shall have occasion to speak of iron cases for rockets under the division of military fireworks.

For paper cases, three or four sorts at least are wanted. For the spiral wheels it is necessary not only that the cases should be flexible, but that they should burn with the composition, as the wheel would otherwise burst and fly off from the support. The paper for these is such as is used for musket cartridges; this being made of new hempen materials, so as to be very strong and tough. If made with the common gray paper of the shops they are apt to burst in attempting to give them the spiral form. A thicker kind of gray paper is required for illumination cases which are of a small size, as well as for all the inferior sizes of fireworks of whatever description. This is commonly termed cartridge paper, being used for cartridges for small ordnance. For the larger sizes of fireworks a harder and thicker quality is necessary; and if larger rockets are to be made, the artist should only use what is properly called rocket paper, which is still thicker, and is condensed by rolling in the mill, in the manner of pasteboard. For the very largest sizes of all, pasteboard itself is preferable, as there is much time saved in the making, and as the work is much firmer.

In making cases, both paste and glue are required; but the first is chiefly wanted. Paste for this purpose must be made as thick as it is for the use of bookbinders and shoemakers. It is usual to put rosin into it, which serves no purpose unless it be that of preserving it longer without moulding. Alum, which is also commonly introduced, is of very little use, except as it may render the cases somewhat less combustible; and glue, if it is in sufficient quantity to have any effect at all, only serves to render it intractable. To keep it from moulding, a little oil of turpentine is the most effectual substance, and a small quantity of corrosive sublimate prevents rats and mice and cockroaches from destroying the fireworks when they are to be stored away for any time.

Spherical Cases.

These are only required for paper shells, and they are to be made in the spherical *former* already described. Being fixed in its stand, which is to form the fuse hole, it must first be soaped that the paper may come off easily when the shell is finished. The paper must then be cut into stripes, which are to be laid to meet round it in various circles like the great circles in a sphere. Other pieces being afterwards laid on in gores till the *former* is covered, the work may proceed with rapidity until it has acquired the requisite thickness, which may vary from half an inch upwards according to the size of the shell. But it must not be so far completed upon the *former* but that it may still admit of more coats after it has been removed. Being thus brought up to a sufficient size, it must be suffered to dry in its place, when it is to be cut into two hemispheres by a saw well greased, and removed from the block. After this, by pasting on a few more coats of paper, the hemispheres are secured, and the shell brought up to the required strength and size. Care must be taken that it be made thus strong enough to bear the explosion of the mortar, as there is no fear but that it will be split by the bursting charge which it is to contain.

Cylindrical Cases.

These are of various kinds, and require some differences in the management, while they all demand considerable attention. The cases for small spiral or firewheels as they are called, must be made by rolling the paper round a wire, which is slightly greased or soaped. Two or three turns of paper, according to its strength, are sufficient for these, as if they are too thick, they will either break in the turning or burst in the firing. The last turns must be pasted, but with as thin and little paste as possible, for the same reasons, and the paper ought to be parallel, so that the case throughout may be of an equal thickness. The cases for leaders to conduct quick match must be made in the same way; but the paper for these should be of a much thicker quality, that it may bear rough handling and bending, as well as the paint with which these must generally be covered. In the wheel cases, lengths from fifteen to eighteen inches are sufficient; but those for leaders may be made of all imaginable lengths, as they are required for so many different purposes.

In making rocket or other cases that are required to fit closely in the moulds, it is proper to ascertain first by trial what length of paper is necessary to make the case of the requisite thickness. Thus all risk of waste or error is avoided, which is important when there is much work to be done. The paper is then to be cut to the requisite size, taking care to have it a little too large in that direction which corresponds to the diameter of the case, that there may be an allowance for that irregularity at the ends which is unavoidable in rolling. At one of the other sides which correspond to the length of the case, the paper must be carefully cut at right angles; that when it is rolled, the line within may be parallel to the axis, without which the rammer may lay hold of the edge, and force it down in driving. This is an accident carefully to be avoided, as it may spoil the effect of a firework altogether. On the opposite side of the paper, the cut is made oblique at an angle of ten or twelve degrees; so that, when rolled up, the edge forms a spiral round the case of about one turn. The wider part being placed at the bottom, is secured by the string which forms the choak; and thus the case is tight at the outer joint, and does not unfold in driving or otherwise. If the case is so thick that more sheets of paper than one are necessary, all except the last may have both the longitudinal sides parallel.

In making up the cases a flat smooth table is required, with a rolling board, which may be about a foot and a half or two feet broad, and which must at any rate exceed the length of the case. It is furnished above with a handle, by which it may be easily held. In pasting the paper, it is better that the last or innermost turns should remain dry, because if wetted, or if any paste adheres to the *former*, it will be difficult to withdraw it. When pasted it is laid near the edge of the table, and the *former* is laid in it with its handle beyond the table. The case is then rolled up as well as can be done by hand, and then it must be placed under the rolling board. By pressing hard on this, and continuing to roll the case thus pasted on the table, it can be condensed to a great degree of firmness; but care must be taken always to roll in one direction, or if that were reversed, the paper would be loosened, and the case be rendered spungy. This operation is completed by the addition of as much paper as may be necessary to bring it to the requisite thickness.

Thus the cylindrical case is made, and the *former* must now be withdrawn while it is damp, as, if suffered to remain till dry, the paper would contract so much as to render that impossible. By fastening a loop round the head of the *former*, or passing a pin through it, a firm hold is secured for it on the table, and the case is then to be taken off by the hands.

It is now ready for choking should it be a rocket or a wheel case. This also must be done while it is damp; and if it has been a dry rolled case, it is necessary that one end should be damped for this purpose. Small cases may easily be choked by the hand; but for larger ones a machine is necessary. This however is very simple, and may be attached to the rolling table. Plate CCCCLXXII. fig. 4. At the lower end of one of the legs of this, there is a foot lever or treddle moving on a hinge. A strong twisted cord of hemp, or, what is better, of gut, is attached to it; and, ascending up to the table, passes over a pulley which is attached to it at the edge. Beyond this it is fixed to the table, so that there is an interval in which the cases for choking may be placed. The cord is sufficiently loose when the lever is up to admit of its making one turn round the case, and the length is easily regulated where it is fastened to the table.

Plate CCCCLXXII. Fig. 4.

The *former* which had been withdrawn, for the purpose of being assured that it can come out, must now be introduced again to within about a diameter, or somewhat more, of the extremity which it is intended to choke. The subsidiary piece with its wire, which was formerly mentioned, is then introduced at that end, so that half a diameter may remain between it and the *former*, which is occupied by the intermediate wire. Being then placed within one turn of the pinching cord, the lever is pressed down by the foot, and the case is rolled backwards and forwards through the turn of the cord, till the artist is satisfied that the wire is closely pinched. After this is done, a piece of strong twine is wound round the furrow thus made, and secured by three half *hitches* and some paste, or pasted paper or glue. The ends of the case are then to be cut smooth and even while it still lies on the *former;* and that near the choke is to be cut in such a manner, that it may have a hemispherical cup exactly equal to half a diameter of the interior. The *former* and its piece may then be withdrawn, that the artist may be satisfied that the first of these is still loose, and the wet case is then to be introduced into the driving mould on the nipple only. By then restoring the *former*, and giving two or three slight blows to it, the mouth of the case is rendered smooth and even. The spindle must then be passed through for the purpose of smoothing the vent hole, and bringing it back to its proper size; or, if it is a rocket case, the hollow rammer and spindle may be used at once, to give the whole of the parts about the vent their true shape and size.

There are some cases, such as those of tourbillons, that require to have both ends closed; and it is convenient to close one of them, at least, in the choking engine. This is easily done by introducing a plug of damp pasted paper, and then pinching the choking rope close round it. Other cases, such as portfires, Roman candles, &c. that are to fire from an open mouth, may be closed at the end in the same manner, as may the cases for crackers and serpents. Such ends in the larger works may be still farther secured by a coating of clay driven on them within.

The cases for illumination lights, or speckies, are made of thin paper, rolled on *formers*, of diameters varying from two to five-eighths of an inch, and their lengths vary from two to six inches. These also are pinched close at one end. Such cases only require three or four rounds of paper, and the last one, at least, should be pasted.

Portfire cases, as well for lighting fireworks as for military service, must be made strong with pasted paper, and the interior diameter, or that of the composition, may be about half an inch. The exterior one is about six-eighths, and these cases must be from twenty inches to two feet in length. The length of cases for rockets, according to their several diameters, will be found hereafter in the table of proportions for these; and, with respect to other fires, they will be more conveniently mentioned when these fireworks come under review.

It is sometimes convenient and ornamental that the cases of some fireworks should burn or flame with the fire; in others it produces a bad effect, or is hurtful. In the fire wheels it adds to the ornament, by producing or increasing the interior white flame. In speckies it is injurious, because the colour of the flame of the paper interferes with that of the composition. In this case, the paper should be impregnated with alum, by which its flaming is prevented; and this is easily done by soaking it in a saturated solution of that salt.

On the General Principles of Composition for Fireworks.

It will conduce to perspicuity to point out the general principles of the compositions which are used in fireworks, as it will also enable us hereafter to class them, in a great degree, in a certain order, according to their affinities and objects; and thus to clear our essay, not only from the confusion that exists in all the common books on pyrotechny, but of many superfluous and absurd receipts and repetitions of the same composition under different names, in which they all abound.

There are four principal objects in all the compositions of fireworks, under which some varieties are included, and some of which are also necessarily combined. The simplest requisite in these is explosion, or the mere temporary blast, designed either for noise, or for the purpose of throwing burning bodies to a distance, or, lastly, for conducting fire from one place to another, through the parts of a simple or complicated piece. For all these purposes, the only composition is common gunpowder, either entire or mealed, according to the particular object that it is intended for.

Next to this are those compositions which are required to produce motion, on the principle of recoil and not of projection, where the piece, instead of the ball, if we may use such an expression, is to be fired away. The sky-rocket is the first of these in which the object is to produce the greatest possible recoil, consistently with the safety of the piece itself; since, if the charge were to go beyond this point, it would burst. In the same class are serpents, together with tourbillons, and the whole tribe of wheels, of whatever construction these may be. For such works force is required, although in different degrees, and therefore, the compositions approximate in their nature to gunpowder. In all of them, the basis is a mixture of saltpetre, sulphur, and charcoal; and, as far as mere motion is concerned, the objects are to be obtained by this species of composition alone. Where the motion is required to be most rapid, as in sky-rockets and line-rockets, the proportions of the ingredients must approach nearest to those used for gunpowder; where less so, as in some wheels, and other similar movements, there the proportions depart more from that. This is done by increasing the quantities of the sulphur and the charcoal, or what is the same thing, by diminishing the proportion of nitre. At the same time, the appearance of the fire may be altered while the force continues the same; as if, while the proportion of nitre remains the same, the sulphur chiefly is increased, the effect will be to produce more flame; but if, on the contrary, it is the charcoal which is augmented, red sparks will predominate.

But, without materially changing the proportions of these ingredients as used in gunpowder, the force of explosion may be diminished by using an imperfect mixture. Hence, when these three ingredients are merely mixed in the way practised by artificers in fireworks, instead of being ground together in the powder mill, they will produce only a manageable recoil, when, if they had been more perfectly united, they would have exploded. In the same manner, the mere act of condensation, by driving, will cause even the most perfect gunpowder composition to burn slowly. Coarseness of ingredients and imperfect mixture produce also, in these cases; another advantage; as the charcoal, which would otherwise give nothing but flame, gives rise, in consequence of its imperfect pulverization, to a torrent of sparks, producing one of the ornamental effects which are desired in fireworks. It is plain, therefore, that the ingredients of gunpowder, which form the basis of all fireworks, are moderated in violence so as to answer the desired end, of a controllable force, by three methods: imperfect proportions, imperfect pulverisation, or mixture, and hard driving. Thus, any one of these can, in some measure, be made to compensate the want of the other two, and, consequently, the same effects are to be produced by compositions of different proportions, or different ones by compositions of the same nature. As ornament in the appearance of the fire is, in most of these cases, no less important than force, so the fundamental composition is modified for that end by various additions. These we shall consider now, in describing the compositions of which the sole purpose is ornament, or in which force is, at least, only a secondary consideration.

There can be but two modes of ornamental fire, namely, flame and sparks, however these may be varied and combined, whether as to colour, or quality, or quantity, or mixture, or alternation, or, according to their mechanical disposition in various kinds of work. A separate management of the composition is required for each of these.

In compositions which are merely to flame, slowness of burning is necessary, and all sparks are excluded, as purity of colour, steadiness, and duration, are the principal objects. Hence the basis of all these compositions must exclude charcoal as far as it is possible to do without it, and the mixtures must also be as minute and intimate as can be effected. Thus, wherever charcoal is necessary, it is introduced in the form of mealed powder, as it is there so fine as to yield no sparks, while the requisite degree of feebleness or dilution is obtained by diminishing the dose of nitre. Such is the general basis of all compositions merely luminous, whether in the shape of cases or stars; and to it the several ingredients intended to modify the colours of the flame are added. All of these must also be most finely powdered and intimately mixed, as it is only in this manner that steadiness and clearness of flame can be produced.

In compositions that are intended to sparkle, the ordinary mixture used for recoil forms the basis. Even this may be rendered sufficiently brilliant by increasing the charcoal, and using it in the state of a coarse powder; but it is also modified by the addition of other sparkling substances, and principally of iron. As this ingredient is extremely brilliant in its effect, it may also be united to the simpler bases intended for flaming compositions; by which means its peculiar effects are obtained in a state of purity. It is so easy to understand how these different kinds of composition may be united or alternated, that it is almost superfluous to mention it. Yet we may give one instance as an illustration, by saying, that if iron be mixed with the antimonial composition for a blue flame, the result will be a firework discharging a blue flame, accompanied by brilliant white sparks.

Of the General Mechanical Arrangement of Fireworks.

The mere fires of works in Pyrotechny being thus limited in point of variety, it is chiefly by their mechanical arrangements and combinations that all their splendid effects are produced. In some cases these arrangements are simple and inherent in the very nature of the firework; in others they are complicated in various modes, so that there is scarcely any end to the varieties which an ingenious artist can produce. As it would be impossible within the limits of our article, to describe even a small part of the arrangements of which they are susceptible, we shall here give a sketch of the general principles by which they are guided, so that an artist of any resource will be able to produce new effects without difficulty. Hereafter, the few varieties which we shall select for consideration will serve for examples of what may be done in this department of the art; and on which, after such general remarks and examples, it would be as little necessary to enlarge as it would be to us impossible.

The leading distinction among fireworks is between those which are characterised by rest, and those to which motion is essential. In the former, the effect depends solely on the quantity, the shape, and the colours of the fire, if they are simple, and on the various ways in which that is directed and combined in compound and complicated works. Gerbes, which throw out a sparkling fire, offer a good example of the simpler kinds, which are indeed rarely used in this manner, without being at least relieved by others, if not united and intermixed with them. It is evident, however, that innumerable varieties may be produced, merely by the combination and disposition of the simplest fireworks. Thus, for example, a bright star may be made by five or six small flaming lights, or speckies, radiating from a centre. In greater number, many such stars may be disposed in various forms, either alone, or in combination with other bodies. When in still greater numbers, such illumination lights may be arranged in lines, or crosses, or circles, or triangles, or in any other figures, and those also may be intermixed in various ways. Becoming more compounded still, they may serve to define the architectural lines of a pyrotechnic building, the other ornaments of which may exhibit all the varieties of fire of which the art is susceptible. Lastly, that we may not dwell unnecessarily on this subject, they may be disposed in the form of letters, so as to express the names of individuals, or any sentence connected with the particular object of the firework which is displayed.

The length and form of the torrent of fire in all the sparkling compositions, render the possible combinations of these still more numerous and various. Effects may be produced by this intersection in this case, which could not in the former; as there also may by the mere quantity of the fire. To put a few of the most obvious instances: If a number of these are disposed in a circle, they may form a blazing star or sun; and by again combining two such circles, the one of which is of larger dimensions than the other on the same centre, an effect still more splendid may be obtained. Three such fires properly dispersed may be made to represent a plume of feathers; four may be caused to produce a cross of fire. Such fires may also radiate inwards as well as outwards, or they may be disposed so as to produce a pyramid, or a cascade; or they may cross or intersect each other from the angles of triangles, or squares, or hexagons, or any other geometrical figures; and in these ways the fires may be directed outwards or inwards, or in both modes at once. Different sizes may also be combined together in various figures; but it would be endless to describe all these possibilities, which may be safely trusted in general to the taste and resources of the artist. We subjoin a few figures in the plates by which a general notion of their construction and effects may be formed.

In the next place, the flaming and the sparkling lights may be combined in an endless variety of ways. The very same case may alternately throw out both the kinds of fire. Or the angles of a sparkling triangle, or of a square, or else the centres of these figures, may be occupied by coloured stars, or their sides may be dotted with such lights; or alternations of figures of lights with figures of sparkling fire may be adopted. Thus, for example, the centre of a sun may be filled with a blaze of lights, while its margin radiates with sparks; or else it may commence with one species, and terminate with another. But, for the same reasons, we need not attempt to describe varieties which only become more numerous as they become more complicated. We must refer to the plates, and to our future examples, for a few such specimens as may serve to illustrate this part of the subject, trusting to the artist's ingenuity for conceiving farther what we may not find room to describe.

The varieties of moving fireworks is much greater than that of fixed, abstractedly considered; yet these are not susceptible of so many distinct and complicated combinations. As the most simple case, we may mention that of burning bodies projected into the air by explosions, such as stars, serpents, &c. whether out of rockets, or shells, or from Roman candles. The sky-rocket is the chief of those which act by their own force of recoil, and the varieties of which it is susceptible will be described when we come to treat of that firework. On a similar principle, line rockets and water rockets produce their particular effects: the principle of recoil being modified by the particular kind of restraint to which they are subjected. In the tourbillon, the recoil of a wheel, or that of revolution, is combined with that of motion in a straight line, and thus the very striking effects of this simple firework are produced.

But the most various effects of recoil in fireworks are produced, by restraining that force within circles, and hence arises the great varieties of wheel movements. The spiral, or pin wheel, is a familiar, but not the most simple case of circular recoil. By suspending a simple cylinder on a pin passing transversely through its own centre, and using lateral instead of direct apertures, a revolving recoil is caused, and hence arises a circle of fire or a wheel. But in works of this nature, which are required to burn longer, it becomes necessary to form larger circles than can be produced from one case. Thus many of these are disposed round the margin of a wheel, or, what is the same thing, on radii proceeding from a centre, suspended on an axle in the same manner as a carriage wheel. This is the common Catherine wheel as it is called; and according to the desired length of time in burning, the cases may consist of any number from two upwards, the effects being altered in appearance by placing these at greater or less distances from the centre. At very small distances, and with great velocity, a continuous circle of fire may be produced; at much larger ones, the form described by this is of a very different nature.

The simple circular recoil may be modified as to its effects, by disposing the fireworks in an angle not coinciding with the plane of the wheel, or radii, on which they fire to revolve. Thus the effort is much diminished according to the resolution of forces, but the figure of the fire becomes entirely different. Such wheels as this are commonly disposed on vertical instead of horizontal axes; and they are susceptible of still further changes of appearance, by alternately reversing the mouths of the fireworks, so that the stream of fire may be directed in an alternating manner obliquely upwards and downwards.

Combinations of circular recoil motions are also managed so as to produce very entertaining effects. Thus if the radii of the larger wheel are caused to carry smaller ones, it is plain that a very compound path of light will be produced by the latter, resembling exactly that path which the moon performs round the earth; the principal circle including smaller ones, which move forwards along an orbit concentric to the first. Other simple combinations of single wheels are also easy; but we shall only here further mention, that in which two, either of different sizes or the same, are caused to revolve in opposite directions in a common centre. The effects of these movements are very lively and brilliant.

As in all such simple wheels the power is sufficient to carry a considerable weight round, if the centres be carefully made, it is easy to attach to different parts of them burning fireworks of different kinds, which have not in themselves any moving force; notwithstanding which, they can be made to produce circles as if they had a power of their own. Thus also, either the cases of the wheels themselves, or others connected with the movement, may be caused to project stars; and in this way also varieties are produced.

As we need not, however, enter now into any more of these general details respecting the attainable variety in simple combinations, we must proceed to notice the general principles on which the more complicated fireworks of these kinds are made. In these, different kinds of the simpler forms, or of the first order of combinations, are caused to act in succession, or together; and thus the further we proceed in combining, the more numerous do the varieties become. Thus moveable and fixed works of all kinds may be united to an extent which is only limited by the size, and weight, and bulk of the machinery, and by the expence. A very few hints on the most general parts of this subject may be useful.

If a complicated succession consists of fixed pieces only, they may be so managed as to fire each other, without any further intervention of the operator than the first lighting. This is done by a proper disposition of the leaders, on which the operator must calculate according to his views. The communicating leader, of course, extends from the end of that which has been burnt out, to the commencement of the one that is intended to follow. If many and distant ones, as in the case of extensive groups of illuminating lights, are to be fired so as to burn together, it may become requisite to have more leaders than one from the same point to different ones, otherwise such works may light in a slow succession instead of simultaneously; in consequence of which, not only the first effect will be unpleasant, but the terminations will be more so, as they will die out in succession, instead of expiring altogether. Such leaders must be so firmly fixed, as to insure them against being displaced by any explosion from the works that have burnt out; and in cases of large and expensive complications, it is prudent to have a spare conductor, known to the operator, so that he may be able to light it by means of his port-fire, should the expected communication fail. In very complicated machines, such as architectural fireworks of great extent, it becomes impossible to produce, or unsafe to trust, the communications to a continuous set of leaders; and proper ones must therefore be provided in different places, that the artist may himself light them when the proper time is arrived.

Now as fire can be conducted from one fixed piece to another, so it may from fixed to moveable ones through any mode of succession that may be requisite. The leader from the last fixed piece may, for example, be attached to the first case in a wheel. To this it must be fixed in such a manner, that the first lighting of the wheel may burn and separate the connection by which the wheel was kept steady in its place. This is easily managed by means of cotton quick-match, which is sufficiently strong to support any thing very firmly, but which is burnt and detached in an instant. But it is not possible to communicate from moving to fixed pieces, as is easily understood. A separate leader is therefore required for all these communications, which is carried away out of the risk of casual fire, and brought under the command of the artist who directs the work.

Of Machinery, Frames, and Transparencies.

Although many of the motions of fireworks can be produced by their own powers of recoil, there are many cases where it is convenient, or even necessary, to have recourse to mechanical powers; sometimes to accelerate these, and thus produce more perfect effects, and sometimes for the purpose of causing movements that could not be made by the fireworks themselves. The framings and supports for fireworks also require some attention to render them as little cumbrous as possible, and at the same time as firm as is necessary to bear the shocks to which they are subjected from recoils and explosions; while it is also requisite that every thing should be done in the most economical manner.

For single rockets, vertical frames or poles are requisite; but we have described these more particularly in our directions for firing this class of fireworks. But when flights are to be discharged together, it is necessary to have a different apparatus. This is usually constructed of successive shelves in which they are placed in alternate order, so that the sticks may stand clear of each other; the whole forming a pyramid. A cheaper and more convenient apparatus, however, for this purpose is formed by making two wide shelves, each perforated with holes, exactly corresponding to each other, sufficient to admit the sticks, and to support the mouth of the rockets. These should be separated to a distance of about two feet from each other, and framed in that position by uprights at the angles, prolonged to the ground; in which they are fastened firmly, so as to form a kind of double perforated table. The matches from the whole being collected together they are easily fired; and their flight is directed by the guide which the position of the two holes for each presents.

The frames to carry wheels are conveniently made of ash hoops, connected by spokes inserted into a nave. It is also proper that the margin of the wheel, whether it be a circle or a polygon, which are equally convenient, should be of considerable weight. If well balanced, as it ought to be, and well centred, the motion is almost equally free as in a lighter wheel; while it has the advantage of acting like a fly, maintaining the impulse which has been communicated to it at first. This is particularly necessary to attend to; because as the cases burn out in succession, the balance becomes injured, and when the weight of these is small in proportion to that of the wheel, their effect in disturbing its velocity is less felt. The centres should be at least two inches deep where they receive the axis, to prevent any irregular motion; made of polished metal, well greased, and with a true axis. The axis may be either fixed into the supporting post by means of a screw; or, what is better, may be kept there ready, and the wheel put on it, and screwed by a linch pin or a nut. For the smaller classes of single cased or spiral wheels, a sufficient centre may be obtained through driven clay or wood, provided it be well greased, and the pins that are to serve for axes are best made of brass or iron, in the form of a thumb screw, with a flat cutting thread, so that they may be easily fixed in the wood and withdrawn to be preserved when no longer of use. These general rules will direct the artist for the management of all the varieties of wheel movements where their own force is trusted to for the motions.

But where wheels are of very large diameters, or the circle of fire is meant to be wide, or when from the cases being disposed in an oblique manner, the velocity is so much diminished that the effect arising from their revolution is injured, it becomes necessary to call in the aid of the mechanical powers, and to apply revolving forces to them. This also is necessary in the use of illuminated revolving cones or globes, or in the countermovements of suns and other complicated figures, as well as in all those works where it is necessary to give motion to transparent paintings. The means of doing all this, which may be varied in an infinitude of ways, both as it relates to the direction and the velocity, cannot be too simple; and it is also proper that they should be concealed from the spectators, who are apt to undervalue a firework that does not seem endowed with the property of self-motion. It is, however, unnecessary to describe matters so simple as a toothed wheel and pinion or screw, which, disposed in various ways, may be made to produce any effects, whether as to direction or velocity. By using the pinion at 45°, the horizontal and vertical directions may be combined, or the one substituted for the other. If the work is of such a nature, as happens in architectural fireworks, as to conceal the operator, this machinery may be turned by hand; if otherwise, a weight running over a pulley is easily applied to a wheel or crank for that purpose.

It would be as endless as it is unnecessary to describe the various forms of frames that may be required; as they must differ with the objects of the fireworks; and we need not, therefore, attempt to direct what an artist can be at no loss in accomplishing. But wherever cases are to be fixed, whatever their natures may be, proper sockets of metal should be provided for receiving them, or pins and hooks to which they may be fastened. The artist must, however, take care that no bounce or cracker be allowed to explode within a metal socket, on account of the risk of injury to the spectators. It must also be recollected, that whatever means are used for fixing these, although it should even be the lights for figured illuminations, they must be firm; as the explosions of the leaders and primings might otherwise displace them, and ruin the effect of the work. Larger cases for gerbes, Roman candles, and other fireworks, that exert much strength, are best secured by having a metal ring with two ears, or flaunches, which may be nailed down to the stands in which they are to be fired.

Transparencies form a very essential part of all fireworks on the great scale, as they are very ornamental, cover large spaces, consolidate all into one great mass, and are very economical in saving many burning fireworks.

For these the pyrotechnist must depend chiefly on the painter; particularly when emblematical figures are introduced, or where architecture is to be represented. In works on this scale, the great mass of the firework consists of transparent painting, and the burning fires are only its ornaments, to be lighted and renewed in various parts of the building in succession, so as to keep up the effect for a great length of time. All these paintings are executed on stout white linen, such as that used for window blinds, if on a large scale, and with the same kinds of oil-colour diluted with turpentine; the whole being rendered transparent where necessary by a coating of drying oil or varnish, and darkened where required by means of black paint. These paintings must be properly stretched on separate frames, so that they may be kept tight, and easily replaced, and taken away from the greater frame-work to which they are attached.

In smaller transparencies, particularly where they are not likely to be wanted again, or where only some temporary inscription or emblem is necessary, paper may be used; but it must be strong enough, and properly secured by means of strings stretched tight across it. In certain kinds of wheels, representing suns and stars, transparencies may be turned to great account by using more than one, and communicating motion to them by means of the revolving machinery. Thus, for example, if one transparency, formed by bright rays, is covered by another behind, so calculated by its colouring as to intercept the light by fits while it is revolving, many splendid effects can be produced. In the same manner, two or more such circular transparencies may be made to revolve in different directions; while, being painted with different colours, a great variety of showy appearances may be caused at a very cheap rate. But we have not room to give designs or farther descriptions of these contrivances; while we may refer for them to books in every one's hands, viz. Hooper, or Hutton's *Recreations*.

As the light of lamps is not sufficiently brilliant and powerful for firework illuminations of this nature, it is necessary to use the burning compounds, such as the zinc light and the antimonial light. The effects may also in this way be varied by adopting different colours, and may be maintained as long as is requisite, by disposing so many behind the transparency, that one may take fire before the other is quite extinguished.

Of Timeing Fireworks.

Of timeing fireworks.

Every thing, in the compound fireworks, whether burning together or in succession, depends on accuracy in the length of their action, and in the precision with which the various parts begin, end, and follow each other. Even in the simplest, a defect in this respect is very disagreeable to the eye; and, in illuminations, the ornamental appearance is very much injured, unless the lights all expire nearly at the same time. In the same manner, it is absolutely necessary that one work should be completely exhausted before another begins, wherever there are mutations; and that no interval of darkness should take place between them. All these objects are to be obtained only by great care in the different parts, in the composition, the driving, the lengths of cases, and the priming, the quality, and the fixing of the different leaders.

Under the head of compositions, we have already pointed out the way in which these are to be managed for this purpose; so that we need now say nothing more on that subject. In filling, or driving, great care and many attentions are necessary; as it is here in particular that the fireworks are apt to become unequal, and thus to go wrong. The measure by which the composition is to be introduced should, in the first place, be a cylinder, and not a shovel, as is commonly the case, as it can always be filled more accurately each time; so that the charge to be driven shall be always equal. Each diameter of case should also have its own measure; and these should all be numbered to correspond with the moulds, by which means all chances of errors from this cause are avoided. In driving, the same mallet should be used for each size of case, and these should also have corresponding numbers. The workmen should also be careful always to give the same number of blows; and this being regulated for each class of cases, from sixteen upwards to sixty, the habit of doing it steadily is easily acquired. But in all larger works, a pile engine, furnished with a tell-tale to keep the account, is the only method to be depended on.

Where there is no such machine, all the cases that are intended to burn together should, as much as possible, be driven by the same individual; and as the chief artist can number each man's work, he may class the cases accordingly; so as to adopt those, of the length of burning of which he is accurately informed. For all things else he must depend on such calculations as he may choose to make respecting the performance of his pieces. But a sample of each kind should be tried, and the time of burning measured by the second's pendulum, when it should be marked on each case; that so when the works come to be put together, the operator may be quite sure of what he is doing, and be able to balance and arrange them accordingly. That accurate time is really attainable in this way, is very certain; because in military works, out of a thousand fuses perhaps, where the time is most important, since the bursting and effect of a shell are entirely regulated by it, it will be found that not a second of difference takes place.

With respect to leaders, it is only necessary that they should act as quickly as possible, since no time is allowed for these; and that point is to be ensured by good quick-match, and careful priming and fitting.

Of Sky-Rockets.

We have chosen to treat of this kind of firework first, not only on account of its beauty, and its universal use in all cases, but because, in detailing the minute attentions which it peculiarly requires, it will be less necessary to dwell on that subject in describing the construction of others. The same precautions and proceedings in every respect, if in a less degree, are required for all sorts of driven cases, whatever their objects may be.

We have, in our table of compositions, given a variety of those which may be used for sky-rockets, but shall here name that one which is best adapted for those of a pound weight, where the original materials, and not mealed powder, are used. This consists of nitre 4 lb., sulphur 1 lb., and charcoal 1¼ lb. The method of making the cases, and the construction of the moulds and rammers, having already been described, it is unnecessary to notice them again.

The measure used in introducing the composition must be so large, that when that is in the case it will raise the hammer one-half of the interior diameter, so that a separate measure is required for each size of rockets. It must be provided with a handle, and be so constructed as to enter entirely into the case, that no composition may be lost, as every thing in the accuracy of the performance depends on these minute attentions. In driving, it is necessary first to give a few gentle blows, that the composition may be condensed before much force is used; as otherwise the condensation of the air would blow it out; and the workman must also take care to turn the rammer, and to ease it in the case before every blow, to prevent it from being jammed by the materials mounting up between it and the sides of the tube. The same number of blows, and with the same mallet and force, must be given to each ladle-full of the composition; as these are essential to a correct performance. In the smaller, or in those which reach from two to four ounces, sixteen strokes are sufficient; a rocket of one pound will require thirty; of two pounds, forty; of four, fifty; and of six, sixty. But beyond two pounds, we must remark, the force of a man's arm is scarcely available, and it becomes necessary, as in the military iron rockets, hereafter mentioned, to adopt the pile engine. We already remarked, that the rammers require to be changed as the composition advances.

When the rocket is filled to the top of the spindle, the quantity of a whole diameter in depth must then be added, in the same manner, by means of the short solid rammer, when the composition is completed. Above this must be rammed one-third of a diameter of clay, which being afterwards perforated by a small gimlet, a communication is made between the rocket and its head.

The sky-rocket, thus far completed, must measure, from the choke, five diameters and a quarter, and the cases must then be cut to that length. The head is then to be fixed on. Where it is judged essential to have the highest flight, its diameter should not exceed that of the rocket, farther than the requisite thickness of its case demands. But as in this way it can contain but a small quantity of stars, or ornament of any kind, it is usually made larger, and so as to exceed the exterior diameter of the case by a quarter of an inch all round, for diameters of an inch. The height is in this case near two inches, and in all other sizes the same proportions are preserved. This case or head is made slender, of two or three turns of paper at most, as it is sufficiently strong if it will bear the ordinary rough usage of packing and carrying; and it is surmounted by a paper cone of the same strength, which, for the same dimensions, is an inch and three quarters in length. If the head is simply larger than the case, it may be glued on at once; but if much larger, a ring of turned beech wood is interposed, and the whole is firmly glued together.

But preparatory to this, it is necessary that the head should receive its charge, whatever that may be. The directions for making stars will be found elsewhere; but we may here say, that if these are made in the ordinary form of balls, or short cylinders, they do not pack close. A better mode is to make the stars in a cylinder of the same diameter as the rocket head, and in the form of sectors, by which means they pack closely in their place. This is easily done by means of an appropriate copper mould, or else the cylinder may be made, and then divided into compartments by a knife before drying. The directions for making serpents, or rains, or by whatever name these ornaments may be called, are also given in their proper places; and we need scarcely add, that the lengths of these must, in all cases, be determined by that of the head in which they are to be enclosed. Before the rocket head is fixed on, care must be taken that the priming hole into the composition is free: as many ornaments of whatever nature as it will contain are then enclosed in the head, together with the requisite quantity of mealed powder, when the operation of fixing it in may be completed. A quantity of this, equal to one diameter, or less, of the rocket, is amply sufficient for bursting the head, and inflaming the ornaments.

These ornaments are not very numerous, and we may describe them in a few words. The stars admit of being made of two or three colours, as will be seen when their compositions are mentioned; but the differences to the eye are so small at the distance where they are seen, that it is scarcely necessary to use any but the blue antimonial one. For the serpents, in the same way, all kinds of sparks have pretty much the same effect at that great distance, so that the most ordinary charcoal composition answers as well as any other. Where stars or serpents are to be used for ground fireworks, these differences are worth attending to, because they are visible. There is a species of serpent, however, called scrolls, which may also be used, and which are made on the same principle as the tourbillon: they are described hereafter. Lastly, crackers or maroons may be introduced into rocket heads, either alone, or in company with other ornaments, and the effect of these is amusing. They may be combined with the serpent or not. If the former plan be adopted, half the serpent case is fitted with the proper composition, and it is then nearly choked and secured; after which the remainder is filled with powder and choked close. If crackers alone are used, they must consist of similar cases filled entirely with powder; but they require a priming of cotton slow-match to give them time, that they may not explode within the head. The discretion of the artist will easily teach him how to vary all these subsidiary matters.

The last thing which remains is to close the mouth of the rocket with a strong covering of paper, and to fasten on the stick. This must be made of very straight deal, and planed smooth. For the rocket, whose dimensions were given above, its length is to be eight feet or more, but not less. At the upper extremity its breadth should be about three quarters of an inch, and at the lower one about a third. It may be wider than it is thick above; but the extremity must be square, that the air may act alike on it in all directions. In fixing it to the stick, it is better if it extends all the way to the rocket head; and it is to be fastened round the case by two distinct windings of twine, which are to be sunk in notches within it, that all unnecessary resistance to the air, or chance of friction in going off the support, may be avoided. The equilibrium should be such, that, in this rocket, whose dimensions have here been taken as a standard, the whole should be poised on the finger at two inches from the mouth of the rocket. This will serve as a general rule for all. But as it is convenient, in the larger rockets, to dispense with length of stick as far as possible, on account of its expence and inconvenience, and, as in the small ones, it is of little consequence how long they are, provided the proper weight and equilibrium are maintained, we shall subjoin a table of measurement on this subject. We need only add, that, if on trial of the equipoise, the tail is too heavy, it may be lightened by the plane; if too light, that part of the stick which is fastened to the rocket may be slipped down a little lower.

Table of Rockets. For one complete.

Diameter of Composition.	Length of Composition.	Length of Bore.	Diameter of Bore at bottom.	Length of Head.	Length of Cone.	Length of Stick.	
Inch.	Inches.	Inches.	Inch.	Inches.	Inch.	Feet.	Inches.
1	5¼	4	⅓	2	1¾	8	2

The same proportions are applicable to all other diameters, except as to the length of stick; for which the following table may be consulted.

Dimensions and Poise of Rocket Sticks.

Weight of Rocket.		Length of Stick.		Thickness at top.		Thickness at bottom.		Point of Equilibrium for the Mouth.	
lb.	oz.	Feet.	Inches.	Feet.	Inch.	Feet.	Inch.	Feet.	Inches.
6	0	14	0	0	1½	0	¾	0	4
4	0	11	0	0	1¼	0	⅝	0	3
2	0	9	6	0	1	0	½	0	3½
1	0	8	4	0	¾	0	⅜	0	2
	8	6	6	0	½	0	¼	0	1½
	4	5	3	0	⅜	0	⅙	0	1
	2	4	1	0	¼	0	⅙	0	¾
	1	3	6						
	½	2	4	0	⅛	0	⅛	0	⅛
	¼	2	0	0	⅛	0	⅛	0	⅛

We may add to these numbers, that a general length may be considered, as 60 diameters for the smaller rockets, and 50 for the larger; that half a diameter is a good general rule for the top of the stick, and a quarter for the extremity; but that provided the equilibrium be correct, they cannot exceed in length, however long; although they will not admit of being shortened, as the steerage depends on the distance of the extremity from the centre of gravity of the whole.

There are many projects for varying the effects of rockets, which are described in the books of pyrotechny, and we shall enumerate them for the satisfaction of our readers. We shall, however, take the liberty of noticing their nature as we go along, as it will be found that some of them are difficult of execution, and others impracticable; or rather that they do not produce the anticipated effects. It is useful to know what to avoid, to save both expence and disappointment; and it will be found that, in practice, modern pyrotechnists have abandoned most of these schemes, although they still stand recorded in their works.

Plate CCCCLXXII. Fig. 6. Caduceus rocket.

The Caduceus rocket, as it is called, consists of two rockets fixed to one stick. For this purpose the rockets must have no heads, as they are unable, from the great resistance which they offer to the air, to carry any unnecessary weight. To enable them to ascend, it is prudent not to place them at a greater angle to each other than 40 or 45 degrees; and, indeed, the less the angle is, so much the more certain and steady will their flight be. At the upper extremity, they must be fastened, the one before, and the other behind the stick. At the lower, they are to be attached to a transverse bar, which is also fastened upon the stick, so as to form an equilateral triangle. But it is to be observed that they must not lie in one plane; and this object is effected by passing the lower extremities on the alternate sides of the transverse bar, in directions the reverse of that which they have at the upper extremity. Thus, the tendency of each rocket becomes such as to compel them to turn in a spiral round the line of flight, forming that particular appearance whence the name is derived. The stick is required to be considerably longer than for simple rockets, and the centre of equilibrium of the whole should be at least one length of a rocket from the vents. In firing them, it is necessary to be careful that they light together, and great care is required in the suspension. With all these precautions, the performance of this compound rocket is awkward and uncertain.

It has been attempted to fire one rocket from the head of another after that is expended, and this invention is called a towering rocket. To put this scheme into effect, a pound rocket will be required to carry a four ounce, in the following manner. The upper end of the large rocket is left unfinished, with a sufficient projection of the case beyond the charge to receive the mouth of the small one. This latter is then fixed loosely into it by means of a little tow, with some paper, lightly pasted round; so that when the principal rocket is expended, the secondary one may have no difficulty in disengaging itself. The stick of the small rocket is brought down parallel to that of the large one, and slightly secured in a similar manner. Thus, when the practice happens to succeed, the small rocket will take fire and continue its ascent when the principal one is done. We must, however, remark, that this is somewhat of a theoretical rocket; a thing not unusual with pyrotechnists. The check which this additional weight gives to the principal one is very apt to derange its flight; while the slightest irregularity in the disengagement of the secondary one will ruin the expected effect, and cause it to overturn and fall down with the burnt stick and case of the first. The effect gained by it is at the same time so trivial, even when it does by chance succeed, that it is not worth the trial and risk of failure. Should any one think fit to try this experiment, it must be recollected that a stick considerably longer than for a simple rocket will be required.

There is a project called an honorary rocket, equally hazardous in the performance, but which we must also describe. In this construction, the case or rocket has no head, for the same reasons. Supposing it be a two pound rocket, as a smaller one will scarcely answer the purpose, a notch must be made in the case, just where the charge and the clay terminate, fitted to receive a transverse case or subsidiary firework. For the size now mentioned, it may be what is called a four ounce case, not exceeding six inches in length. This is driven solid with the same composition as the rocket itself, or with that used for tourbillons, since it is in fact a tourbillon, and is closed at both ends. It is then bored with two deep gimlet holes close to the extremities, on opposite sides, and so that the direction of these is at right angles to the rocket, or horizontal. The case thus finished is fixed to the top of the rocket, and a leader of quick-match is brought from each of its openings to the hole which communicates with the end of the composition, after which the rocket head is covered, as usual, with a paper cone.

The effect of this is easily understood. When the rocket is expended and the stick has turned to descend, the transverse case takes fire at both ends and spins round the line of descent, so as to form, if successful, a spiral line of fire. This case may be tied on the stick instead of being fastened on the rocket itself, the stick for that purpose being made so as to pass beyond the rocket head; but this method is less likely to succeed, as interfering more with the flight. It has been attempted to produce the same effect in a more perfect manner by perforating the transverse case in the middle, and fastening it upon a spindle fixed in the top of the rocket. But this is too complicated; and, upon all these contrivances we may remark, that although theoretically practicable, and sometimes successful on trial, they are apt to fail in the fundamental object, by interfering with the ascent of the rocket itself. The operator must recollect that a rocket, in its simplest state, and when least encumbered, is a very delicate and ticklish machine, and that it will not easily bear to be tampered with. In all these contrivances, it is necessary to have a longer stick and a more distant point of equilibrium than in simple rockets.

A tourbillon may also be combined with a rocket in the act of ascending, but, on account of the weight to be carried, the rocket must have great power. Thus, a two pound rocket will not easily be induced to carry more than an eight ounce tourbillon. In making this attempt the tourbillon must be made complete, as when it is to be fired alone; that its own force of ascent may assist that of the rocket. But it need not be so completely bored; we must, however, be more particular. The transverse case being driven and closed at both ends as before, with the same composition as the rocket, the two horizontal and opposed holes at the extremities are to be bored and prolonged obliquely into the case for about a diameter and a half in length, that the force of the issuing fire may be sufficient to produce a circular recoil. Thus, the tourbillon becomes a wheel revolving round the line of flight of the rocket. When it is fixed on the rocket head, two holes must also be bored, simply into the case, one on each side of it, and directed downwards, so that each will produce a stream of fire to assist in the rocket's ascent. Care must be taken to secure the leaders from each of those four holes in such a manner that they may all take fire as soon as the rocket is ready to quit the support, which is easily managed by bringing that which unites the whole, down to the mouth of the rocket, and by putting about a quarter of an inch of a slow composition into its mouth, so as just to retard for a couple of seconds the communication between the mouth of the rocket and the quick-match of the leader. No hole is required at the top of the rocket in this case, but it must be covered as usual, with a cone, to diminish the resistance of the air. Now, as it is essential in this contrivance, that the rocket should be so balanced as to turn round its own axis in ascending, it is requisite that the stick should be round instead of square, and that instead of being attached to the side, as usual, it should be prolonged from the axis. This is managed by fastening it to two metallic stays of light tinned iron, embracing the opposite sides of the case, so that the stick may not commence till the place where the point of equilibrium is situated, which ought also to be a full rocket length from the vent. This stick ought also to be of unusual length itself. We may add, that the effect of this compound rocket is extremely striking, but that it requires the greatest nicety in the execution and in the firing.

The fire of a rocket may be varied in a pleasing manner by dispersing it during the ascent, so as to produce a wide or divided shower instead of a simple train of sparks. To produce this effect, a plate of tinned iron, of about the size and figure of a half-crown, must be fastened on the stick about two inches below the vent, so as to meet the stream of fire as it issues. The method of doing this is too simple to require any detail, and the effect of it is easily understood.

It is possible to attach two or even three rockets to one stick, so as to produce as many ascending streams of fire, and this project is recommended in the books of pyrotechny. In this case a much larger stick is of course required. But we cannot recommend this contrivance. It is very difficult to make it succeed in the firing, and the effect, when it is attained, is so little better than that of a rocket of larger size, as not to be worth the risk of failure. A similar attempt, with a slight variation, has been made to fire many rockets in one mass. These are known by the name of chained rockets. To do this, six or more rockets are fastened parallel to each other by means of packthread or otherwise, each having its separate stick; and the whole are fired by one leader. It has also been attempted to connect them loosely together, so that they may be in a certain degree independent of each other. This also is done by means of packthread. But in all these schemes we must remark, that the chances of failure are so great, that they are not worth trying, particularly as the effect, should it succeed, is not very good. Where they are strung loosely together, in the manner last mentioned, they are particularly subject to become entangled and go wrong.

Simple rockets may be used with reports only instead of ornaments, and their effect is good, while they serve to excite the attention of the spectators where that is necessary, preparatory to some general display. In making this kind, after the clay has been driven on the top of the composition and the priming hole bored, a diameter and a half of the bore must be filled with powder above it. The case must then be secured above this bouncing charge with a wadding of tow and glue, as it would destroy the explosive property of the powder were it to be hard driven with clay, and as it is impossible to choke the case above it. A cone is then added for the usual reason of diminishing the resistance of the air.

There are two methods of carrying a single light by means of a rocket, instead of using the common ornament of stars, which are quite practicable, and have a very good effect, although not mentioned in the books of pyrotechny. For both, two diameters of the case must be left empty above the clay. This is to be filled with the same antimonial composition which is used for signal lights, or with that from zinc, both of which will be found mentioned in their proper places, according as it is wished that the light should be white or blue. It must also be rammed in pretty firm, so that it may not fall out when the rocket oversets to descend. This light may be caused to descend after the rocket is burnt out, in which case the effect of it is very agreeably prolonged; but care must be taken that it may not alight on the ground where it could do any harm, as the white light produces a very strong fire. If this practice is to be adopted, a hole must as usual be bored through the clay on the top of the rocket charge, and also through the white light, that it may take fire at the surface: this hole is to be filled with mealed powder. But if the rocket is to carry the light upwards in ascending, such a hole is unnecessary. Instead of it, a leader must be conducted from the mouth of the rocket to the head, which, in this case, will not require a cone; or else the light on the head may be fired before the rocket; which answers the purpose equally well. It is also easy to make the light of sufficient duration to last through all the time of the ascent and descent both.

Rockets may be ornamented in some other ways during their ascent, and be thus made productive of additional variety. Thus they may be made to discharge serpents during their flight, either at one or more intervals, without interfering with the final discharge from the heads. To effect this, a ring or more of small serpents, as the artist may desire, may be fastened round the rocket case by means of cotton slow-match. The loose end of that must be fired at the same time as the rocket, and its length so calculated as to burn three, four, or more seconds, according to the part of its ascent where it is desired that the serpents should be discharged. This cotton match must also communicate with a quick-match priming to each serpent. Thus when the fire arrives at the serpents, it not only lights the whole ring, but, by burning the match which attaches them, sets them at liberty. If two or more discharges are wanted, as many rings of serpents may be placed round the rocket, and the match duly proportioned so as to light each set in succession.

As a powerful rocket will carry considerably more weight than its own stick, advantage may also be taken of that, so as to add to its ornamental appearance. Thus a small case with a sparkling composition may be attached to the end of the stick, with the mouth downwards, which must be lighted independently of the rocket; but the operator must of course take care, in adopting any of these contrivances, to ascertain previously what weight his rocket is really able to carry. Another pleasing ornament may be produced, by placing a few illumination lights or speckies along the stick, or by attaching a larger one to its end; but whichever of these several plans is adopted, care must be taken that the rocket has great freedom in quitting the support on which it is fired.

Rocket with parachute.

The last project for varying the effects of sky-rockets which we shall mention, is that of causing them to suspend a white light in the air after they are burnt out. It requires some little care to make the requisite machinery, but it is neither expensive nor difficult. For this purpose a parachute is attached to the rocket, which is so combined as to open when it is expended, and thus to check the descent of the case and stick. The parachute for this purpose may be applied in different ways; but is perhaps most conveniently done in the following manner: Being made of four or more pieces of slender whalebone, with a thin piece of linen stretched over them, it is attached to the lower end of the rocket just at the choke, so that its open end may lie upwards. Thus when the head of the rocket is turned downwards the parachute will act; and care should be taken that it does act freely, and without turning inside out, before any attempt is made to complete the arrangement. The rocket head is then filled with a white or blue light, in the manner described before, with a priming hole communicating with the top of the composition. A hole is also made in a lateral direction, for the purpose of carrying a leader to disengage the parachute at the moment the rocket is burnt out. The parachute must then be collected neatly round the rocket with the points upwards, which are to pass beyond the head, and to be enclosed in a light paper cone that may easily be disengaged. To insure that, the cone is made in two parts, and secured by a bit of cotton quick-match, which is to be also conducted in a spiral manner round the rocket and parachute together, so as to render the whole as compact as possible, after which the whole is to be covered with a single fold of weak paper. This quick-match is connected with the leader from the rocket head, and with that which serves to set the light on fire; but it is necessary so to arrange these two leaders, that the parachute may disengage itself before the light takes fire. As soon as this match is burnt, the parachute is disengaged; an effect which may be aided by forcing the whalebone ribs together, as is easily comprehended; and as the weight of the rocket cases causes it to overset as soon as the composition is burnt out, the parachute is then brought into action, so as to suspend the light, which thus continues to burn as it descends slowly. We need scarcely add, that many minute attentions are required to make this act well, but that a dextrous mechanic can find no difficulty in it.

The parachute may also be attached to the middle or end of the stick; but in this case great care must be taken that the leader which is to disengage it may not take fire by the burning of the rocket, until it receives its fire from the end of the composition. For this purpose it must be made strong where it passes below the rocket, and is exposed to the stream of fire.

On the height to which Rockets ascend.

In Mr. Robins's trials, the pound rockets were found to ascend perpendicularly, from 450 to 500 yards; and from some measurements made in the flights of those that were used at the great firework in the Green Park, they were found to range from 440 to 526, in general; although there were some that rose to 615 yards. Mr. Robins also seemed to think, in his first experiments, that all sizes of rockets had pretty nearly the same flight. This, however, is not the fact. The ratio of increase indeed is not regular, nor does the ascent correspond in any way to the magnitude of the rocket; but the greatest ascents, or the longest ranges, if fired at an angle of 45°, are obtained with the larger sizes. The time for these ascents varies from ten to fourteen seconds. That time does not bear a regular ratio to the altitude of the ascent; because a considerable part of the force of the recoil is lost in overcoming the inertia of the rocket. That time, of course, is the same for all; so that those which have the power of flying highest, increase their ranges, as these regard the time of flight in a certain progressive ratio.

Taking Mr. Robins's computation of 600 yards for the limit of ascent in signal rockets, that gives an elevation of one-third of a mile nearly. Hence if the light of the exploded stars, which are the proper ornaments of a signal rocket, is sufficiently strong, and the atmosphere is clear, such a signal may be seen at a horizontal distance of fifty miles at sea, or in a level country where there are no advantages. Its rise above the horizon is sufficient to render it quite visible. Mr. Robins need not have doubted if the light was visible at such distances; as it has been ascertained that the common blue antimonial light, which burns from a case only an inch in diameter, may be seen at the distance of seventy miles without difficulty, and probably much more. In this the mass of light is considerably less than that produced by the stars of a signal rocket, and the composition is, as nearly as possible, the same in both.

In a subsequent set of experiments made by Mr. Canton and Mr. Robins together, rockets of two inches and a half in diameter were adopted. Some of these rose to 500, some to 600, and one to 690 yards; and here, contrary to Mr. Robins's former opinion, it was invariably found that the largest rose the highest. Some larger rockets were afterwards made by Mr. Da Costa, of about three inches and a half in diameter; and in these, the vertical ascents were 833 and 915 yards. Another trial made with one of four inches in diameter, gave a perpendicular flight of 1190 yards. The last of these experiments was made in April 1750; and on that occasion there were twenty-eight rockets fired, made by different persons and of different sizes, varying from the diameter of an inch and a half to one of four inches. The most remarkable flights of these are here tabulated, for the convenience of inspection.

Diameter.	Ascent in Yards.
Inch 1½	743
Do. 2	659
Do. 2½	880 to 1071
Do. 3	1254
Do. 3½	1109

In these experiments, the four inch rockets failed, having overset in their ascent; probably from negligence in the stick, or too great a length of charge.

At the same time, trials were made on the largest sizes of rockets which, as far as we know, were ever constructed. These were twenty-four inches in diameter; one of them rose to 784, and another to 833 yards. It is evident that these are both failures; and we have no doubt they are to be attributed to defects in the construction. It is not possible to use exactly the same proportions, either in the length of the case, the proportional length of the bore, or the nature of the composition, in large as in small sizes. If Mr. Banks's and Mr. Da Costa's largest rockets were formed on the scale of the one pounders, it was impossible that they should have succeeded. In such cases also, the stick, the cap, and all the minuter parts of the rocket require a degree of care to obtain the best results, which are of little comparative moment in the smaller calibers. Nor is it possible that rockets of such enormous diameters could have been driven properly by hand, as it is probable these were; the pile-engine not having been generally introduced till it was applied by Sir William Congreve to his military rockets. Thus, then, the failure of these large machines may easily be accounted for, without assuming, as these experimenters or their reporters have done, that the sizes of rockets could not be augmented with advantage.

But we imagine that a very serious additional defect arose from the use of paper cases. If these be adopted, the diameter of the whole rocket becomes so rapidly enlarged in proportion to that of the composition, that the resistance of the air increases in a great ratio, and thus the flight becomes materially retarded, and the range consequently diminished. Such increase of resistance is often opposed to the ascent of the smaller signal rockets, by making the diameter of the head larger than that of the case, a practice very properly exploded in the one pound signal ones made for the service of government. It is not improbable that this cause was superadded to all the rest in the case of these very large ones; as the value of the air's resistance was not at that time thoroughly estimated. Mr. Robins's experiments on this subject, as applied to the purpose of calculating the fall of a shot had not long been made, and were not sufficiently before the public to have attracted the attention which they merited.

We cannot therefore agree in all the conclusions of Mr. Ellicott on this subject. In his report, read before the Royal Society, he says, that "not only is the making of large rockets very expensive, but much more uncertain than those of a lesser size." "It is also evident from the experiments, (those, namely, above mentioned,) that rockets from two inches and a half to three inches and a half in diameter, are sufficient to answer all the purposes they are intended for," &c. &c. They are unquestionably much more expensive and difficult to make when of a large size; nor, as signal rockets, is it necessary that they should be so large, as it is very seldom that it can be required to make or receive signals from distances of fifty miles. But it is far from true, that the greater ranges may be obtained from the smaller sizes if the rockets are well made; and though these ranges are not required, either for signals or for purposes of amusement, they are of great importance in using rockets for military service.

Sir W. Congreve's improvement.

This matter has been proved, and the question set at rest by Sir William Congreve's experiments; he having, by the adoption of iron cases, materially reduced the resistance, while he has also made various improvements in the proportions, in the composition, in the sticks, and in all the minor details, the neglect of which before his time had been the common causes of failure. The amplitude of his ranges, and of course the vertical elevation, (were that wanted,) have been thus materially augmented: but we shall have occasion to notice the nature and construction of the iron rockets, in that part of our article which relates to military fireworks.

Ellicott's experiments.

When Mr. Ellicott's report was presented to the Royal Society, the heights given for the flight of these rockets was received with incredulity, and were supposed to have arisen from the imperfect method of measuring the elevations by means of one quadrant only. There is no doubt, however, that if they were not absolutely correct, the general results are sufficiently true. They have, indeed, been amply confirmed by computing the vertical elevations of the Congreve rockets from the lengths of the ranges; a task not difficult; as from the continued action of the rocket during the time of flight, the path forms a much more regular and manageable curve than that of a shot through the air, where the action of gravity in causing what would be only such a regular deflection as would produce the parabola, is exceedingly modified by the retardation produced by the air, which commences from the first moment that it quits the gun, and acts unequally till the very moment of its descent.

Experiments by the author of the article.

But that no doubts on this subject might remain, we repeated the experiments on the ascents, with signal rockets; using two quadrants at once, that the errors of observation might be diminished, and rejecting all the flights which, materially deviating from the perpendicular, would have given false results and disturbed the general averages. The mean ascents of pound rockets were thus found to be 480 yards, the greatest being about 520 and 530, and the least at 450 and 460. We shall conclude this part of the subject by adding, that the vertical power of ascent, in the Congreve rockets, as in others fired at an elevation of 45°, may be computed from the theory of the parabola. The flight of a rocket is not indeed exactly in this curve; but the difference of its path from that line is not sufficient to introduce any error into a computation formed on this basis, greater than those which would arise from an actual measurement of the vertical ascents.

On the Firing of Rockets.

On the firing of rockets.

There are various modes of firing rockets when intended for purposes of amusement or ornament, but we shall first consider the discharging of single ones, whether used with that view, or as intended for signals. So much in the performance of a rocket, whether in the altitude of its ascent or the verticality of its direction, depends on the care used in firing, that it is impossible to be too particular on this point, as the very best made ones may fail for want of proper attention to many minute points.

The method of priming them is the first thing to be considered. If rockets are under the pound size, it is unnecessary to be curious about priming, or even to prime at all. They may be lighted at once, even without breaking the paper bottom, by means of the portfire. But it is not prudent to follow this practice with the larger dimensions. If the port-fire is held too long at the vent-hole, which may easily happen, the flame may spread suddenly so far up into the bore, as to produce a slight explosion. It is not often that a rocket will burst from this cause; but it may be so far shaken out of its place on the post, as to take a wrong direction on going off, and thus the perpendicularity of its flight, reckoned so essential to the beauty of the performance when for amusement, and so important in the case of signals, may be disturbed. It is particularly necessary to be cautious in this point, when signal rockets are used on board of a ship; because not only the object may be defeated, but the rigging endangered; an accident that might prove serious should there be any sail set, as the canvass might easily be fired.

It is therefore always prudent to prime the larger rockets. This is to be done by means of a piece of quick-match introduced into the vent; but, for the same reason as in the use of port-fires, it must not be pushed beyond an inch upwards into the bore, where it may be steadied by a little bit of tow. In the same way it must be fastened to the stick, close to the vent, that it may not drop out, and the tail of it may then hang loose for the engineer's port-fire. When the weather is doubtful, or indeed in all cases, it is prudent to enclose the quick-match in a paper tube. This may further be secured within the mouth of the rocket, by pasting some paper round the whole, so that every thing is secured from any accident in consequence of sparks or carelessness. In wet weather, it must be painted after being thus primed, and, in this way, no disappointment can follow.

Rockets are often discharged in flights, particularly in fireworks on a very large scale, where they are distributed in various places about the buildings, so as to relieve the spectators' attention among the illuminations and figured movements, and to rouse it when about to flag. In cases of great rejoicings, when large crowds of the lower orders are present, so as to prevent each other from seeing straight forward, flights of rockets are particularly necessary, as it is often the only part of the spectacle which many of them can enjoy.

Such flights may vary from 100 to 1000 and upwards, and they are extremely striking when great numbers are fixed together. That they may fire together, however, it is necessary that they should be regularly primed with quick-match in the same manner. The bit of match being introduced into each, and properly secured to the sticks, the whole of the tails are to be collected and made fast to a common leader, to which the engineer applies the port-fire. Sometimes they are fired by strewing powder under them on the frame. But this practice is not safe; because some of them may miss fire while others burst; and, in any case, their lines of ascent will be disturbed and irregular.

To return to the simple case, and suppose that the single rocket is primed and ready for firing, it is proper to describe the mode in which it is to be disposed for flight upon the support. Very small ones may be held in the hand, by means of the stick, and let go in this manner; but it is impossible to insure a vertical ascent by this method. On board of ships, it is not uncommon to place the stick in a musket barrel, and to discharge them from that. But this also is an imperfect method. It is impossible to place the musket in a perpendicular position, or to retain it in one; besides which, if the stick is long, as it is in the one pound signal rockets, and the case heavy, the former bends, in consequence of its elasticity, so as not only to throw the rocket off the perpendicular, but to make its direction uncertain, as it wavers about from side to side before it is fired. In this way also the weight of the case serves to bend the stick in such a manner as to make it adhere to the muzzle of the piece during its oscillations, by which accident the flight may be materially retarded as well as disturbed; while the people near it are also annoyed by its fire before it starts.

On board of a ship the best place for discharging the signal rockets is near the poop, on the quarter or stern railing, to which a perpendicular spar should be lashed for the purpose. Two round nails, driven in near the top, may serve for the rocket to rest on; these being just wide enough to suffer the mouth to hang freely upon them, so as to leave plenty of room for the stick. Two pairs of similar nails, placed at proper distances below, will serve as guides to the stick till the rocket is clear of the post, and has acquired its proper direction. But it is much better to have a pole properly fitted for this purpose, by means of smooth round loops, fixed at proper distances, through which the stick is to be passed. The pole should also be set up as near the perpendicular as possible, by means of a plummet, which may be tried upon it when erected. A musket bullet and a string will answer all the requisite purposes. These precautions are all very necessary; partly to insure a good flight, and partly to avoid the chance of the rockets interfering with the rigging.

The same kind of simple stand answers the purpose, also, on shore, when rockets are fired for amusement. But as, in most of those cases, there are commonly crowds of people collected, who might be endangered by the falling of the sticks, it is necessary to throw the rockets so far off from the perpendicular as to avoid all hazard of their falling back into the crowd when they are burnt out. In the same way, the engineer may choose some piece of ground where they may fall with the least injury, avoiding houses, or places where there may be corn or hay or other combustibles, and choosing a piece of open meadow ground or other naked land. By knowing the altitude of ascent, it is very easy to compute the necessary inclination for this purpose, without, at the same time, causing the rocket to deviate so far from the vertical line as to destroy its effect. Spectators always judge of the perfection of a rocket by the perpendicularity of its flight, unaware that this can never be attempted without the greatest risk of injury to themselves.

This danger is far from imaginary; even in the half-pound rocket, the fall of the stick, from a height of 400 yards, is sufficient to give a very hard blow. The weight of the one pounder stick, descending from its usual height of 500 yards, is very considerable, and indeed sufficient to kill a man. They have been known to break an arm, and after that to penetrate deeply into the ground. We have seen them pass through both the wooden sides of a drum, which is made of a very tough ash hoop, and then enter the earth to a foot in depth.

For this reason, when flights of rockets are fired, as there are generally crowds present, and as it is impossible to regulate their directions, these should never exceed half a pound; but even the quarter pound size is preferable. These are sufficiently showy; they ascend 300 yards, and the fall of the sticks can do little harm, unless a chance spectator should receive one in his face. Fortunately, they generally retain fire enough to forewarn idle people of this kind of danger.

The last circumstances which we shall notice respecting the firing of rockets, are the methods which have been proposed for increasing their range or ascent. It is evident, on the slightest inspection of a rocket when about to rise, that a very large portion of the composition is burnt before it is able to quit its place, or, in mathematical language, there is a considerable portion of the force expended in overcoming the inertia, just as there is when a team of horses first attempts to set a waggon in motion. When once the motion has commenced, a very small addition of force is sufficient, not only to sustain the velocity against the resistance of the air and the force of gravity, but to add to it progressively till it has attained the maximum, or till all these forces are balanced. Now, if the initial velocity, or any velocity could be communicated at the beginning, all that would be saved in the burning of the composition, and, consequently, the extent of range or of ascent, would be proportionally augmented. This is but an imaginary advantage, as we shall immediately show. Let the mean times of flight and elevation of the one pound signal rockets be taken, respectively, at twelve seconds and 500 yards, which is near enough to the truth. Now, in firing, about two seconds are expended on the post, in the attempts to first overcome the inertia of the rocket, and two more in communicating to it a velocity considerably short of the greatest which it will acquire. We may therefore consider three seconds expended in overcoming the inertia, or in placing the rocket in a state to derive all the advantages which it might from its own power of flight. This amounts to just one-fourth of the whole time of burning. It must not, however, be considered as accurately representing the time which is lost to the flight, as the rocket does not acquire its full force till the bore has become so much enlarged by the fire as to give issue to a considerable torrent of fire, or, correctly speaking, stream of air. Were we to consider it as a true measure of the loss of range, we should find that the pound rocket, burning twelve seconds, and rising 500 yards, would lose a fourth part of its range, or 122 yards nearly; but we shall probably not be very wide of the truth if we take it at 80.

But if this is not of much moment in ornamental rockets, or even in those used for signals, it is of considerable consequence in military or projectile ones, in which the length of range is of great importance. And if we attend to the nature of the curve formed by the flight of the rocket at 45°, we shall find that the variations in the amplitude of projection, or in the actual random, are of even more moment than those in the perpendicular ascent. The same reasoning applies to those cases in which rockets have been used to throw out lines to ships in distress on a lee shore. Now, it has been attempted to overcome this inertia, or communicate an initial velocity by firing the rockets from a piece of ordnance. But the blast of the powder ruins the composition, and frequently breaks it, so as to cause the rocket to blow up in the piece, or in the frame where it is fired. This, in the case of the iron rockets in particular, is a very dangerous accident, which renders them almost as formidable to the artificers as to the enemy; and it has in more than one instance been attended with fatal results.

Lately it has been attempted to gain the same end by introducing the stick only into the piece to be fired; by discharging the rocket in this manner, in fact, from a musket. But this is almost equally dangerous, as the composition will not bear the blast which issues from the mouth of the piece, even at that distance. The moment it cracks, the fire enters from the bore into the fissures, so as to set fire to more composition than there is vent for; in consequence of which, an explosion is unavoidable.

The only safe method of gaining this end is by means of a balista, or cross bow. It was by this machine that the Saracens and others threw their fireworks, as we mentioned in the historical part of this article; nor can there be any difficulty in applying it to the rocket. The balista should be formed on the same principle as the cross bow, with a steel spring, and a sufficient force of machinery to bring it to the bearing. The trigger is to be provided with a string, for the purpose of discharging it at a proper distance. Where the bow-string comes near to the fire of the rocket, it should be guarded by a copper wire; but it would be still preferable to use strings made of the best German wire, twisted manifold. In place of one string also, two may be used, connected in the middle by a solid plate of metal, where the fire might reach so as to injure it. This balista has for its support a bar of sufficient size and strength to receive the rocket, and furnished with loops, also, for the purpose of retaining it in its proper position, as it flies off. In firing, however, care must be taken that no blow, or impulse, be given to the rocket, for fear of shaking the composition, and producing the effects above mentioned; but that the contact of the string should be perfect, that it may pass off the support without a shock. It is scarcely necessary to observe, that the priming must be lighted before the trigger is pulled; and the composition ought, indeed, to burn for at least half a second before the rocket is discharged.

Of other Uses to which Rockets have been applied.

Of other uses to which rockets have been applied.

In our remarks hereafter on the iron rockets, under the military branch of Pyrotechny, we have mentioned their uses in the whale fishery.

We have only here, therefore, to notice a project for rendering them of use, as just mentioned, in relieving ships in cases of going on shore. The original project of this nature was formed, and not only formed, but published and practised by Lieutenant Bell, of the Royal Artillery. It was, however, neglected by those who ought to have taken an interest in it, but was afterwards revived by Mr. Manby, who obtained from Parliament the splendid reward which, if any where, was due to the inventor. This consisted in throwing a line out of a piece of ordnance, attached to a shot. If, from the shore to the vessel, the elevation was so given as to cause the shot to range beyond it, so as that the line might fall on board across the ship. If, from the vessel, this precaution was unnecessary; and in case of any vessels being acquainted with this expedient, and having the requisite implements on board, the chances of success were, perhaps, somewhat greater. It must be recollected, however, that very few coasting or trading vessels are provided with a piece of ordnance; and that, even if they were, it must generally be impossible to use it, under the circumstances in which a vessel is aground on a lee shore.

Lately, as an improvement on this method, the same Mr. Manby and a Mr. Trengrouse have proposed the use of a rocket. A small line is attached to it below, which is carefully coiled up like a whale line, so as to deliver freely. Being thrown on board the vessel in such a state, it may be made use of to attach a stronger line to, and so on in succession, till a hawser can be carried on shore. It is evident that this project is more applicable than a piece of ordnance, if it is to be carried by the ship itself; as, if fire can be at all produced, a rocket may be discharged under any circumstances.

Causes of the Flight of Rockets.

Causes of the flight of rockets.

There needed not to have been much dispute on this subject at any time, as the causes of the ascent or flight of a rocket ought to have been sufficiently evident. Yet, when such philosophers as Lemery, Wolf, Papin, and many others, considered that the explosive, or expansive force of gunpowder, depended on the rarefaction of air contained in the interstices of the grains; when John Bernouilli imagined that it contributed part of the force; when Muschenbroek, Stahl, Beaumé, and Macquer, considered that this effect arose from the conversion of the water of the nitre into steam, whereas nitre contains no water; when Count Rumford followed in the same track; when Lombard added to this the conversion of the nitric acid into vapour; and when, lastly, others attributed the elastic force of gunpowder to the radiation of disengaged caloric, it is not very surprising that the cause of the flight of a rocket should have been as much misunderstood.

Since the true cause of the explosive force of powder has been known, some unaccountable errors have been committed in attempting to solve this question. Some philosophers, forgetting themselves, have imagined that the effect arose from the generated fire or flame, as they considered it, acting on the vent or choke; an action which, it is very evident, would tend only to burst the rocket, not to make it fly. But we may pass by these errors, since there is no difficulty whatever in the question. As the powder or the composition, which does not differ very materially from that, is condensed to one-half the space which it occupies when in a gun, the production of air, proportioned to the bulk of this composition, is nearly double what it is from gunpowder in a charge. If taken according to the relative weight, it approaches nearer to that; but is still inferior, on account of the greater disproportion of the nitre necessary to insure a fire sufficiently slow, whence the whole of the charcoal is not converted into gas. But as it is not necessary to be very accurate for the present purpose, we may consider that the rocket composition produces 500 times its bulk of gas at the mean temperature of the air, while its elastic force is increased by the heat to not less than 2000. Thus the rocket of three inches diameter and two feet long, (to assume a case,) will furnish 96,000 cubic inches of gas at the same density as the atmospheric air, at the same temperature, or at the elevated one at which it is actually generated, 884,000.

In the rocket, now, of the assumed dimension, the whole of this fluid must be discharged within the space of 20 seconds from an aperture of 1½ inch in diameter; and this, therefore, requires an issuing velocity for the stream of air, (or flame as it is called.) equal to that which would result from 19.200 cubic inches flowing in a stream of that diameter through every second of time. Here, then, is the source of the moving power, which becomes a case of recoil precisely analogous to that which takes place when a piece of ordnance is fired. The resisting body in this case, as in that of a piece of ordnance fired without a wad or a shot, as is done in Dr. Hutton's pendulum, is the air; and the flight of the rocket thus depends on a comparison between the weight to be moved, (adding to it the effect of gravity and the anterior resistance of the atmosphere,) and that of the resistance which the air opposes to the issuing current.

We have here assumed grounds of computation which are not exact, but quite sufficient to explain the general principle. But it is plain, that, with accurate data, such as the exact quantity of composition contained in the rocket, the exact quantity of gas which a given weight of it would produce, and a true measure of the temperature, the problem that relates to the velocity of a rocket at any one point of time, and so on for the whole flight, might be calculated. Dr. Hutton's elements of calculation for the initial force of gunpowder might, with the necessary addition, be applied to the solution; if not with accurate results, when the intricacy of all the circumstances are considered, yet with not much less than in the case of the firing of ordnance, and the quantity, whether of the recoil or the propelling power. But our readers would not thank us to enter into these calculations with the requisite accuracy, even if our limits permitted us to enlarge on this part of our subject.

We shall, therefore, draw in on this question, and only further say, that in considering the nature and action of this force, it might probably be made use of to advantage in obtaining that end of which we spoke before, namely, overcoming the inertia of rockets. To effect this purpose, a solid obstacle or plate affixed to the frame might be opposed to the issuing current of air, which, by offering a steady and firm resistance to it, would produce a far greater *initial effect* than can be obtained from that of the atmosphere merely.

From this explanation of the action by which a rocket is caused to fly, the reason for its very peculiar construction becomes evident. If there were no bore, no part of it could at any time be inflamed greater than an area of the cylinder; and the air produced from so small a surface would be insufficient to communicate the requisite velocity. In consequence of the size or length of the bore, nearly the whole length of the composition is inflamed at the same time, and hence a rapid issue of air is the consequence. Hence also we can understand why the velocity of a rocket tends to increase during every successive part of its flight; because as the diameter of the bore becomes enlarged by burning, a much greater extent of surface is occupied in the production of gas. Hence also the cause of bursting becomes evident; as, in cases of fracture of the composition, so large an extent of it may take fire, that the air cannot find a sufficiently free issue at the vent. The necessity of choking, or of contracting the vent hole, must now also be so evident that we need take no notice of it.

It remains yet to inquire respecting the use of the stick, and the deviations to which the flight of a rocket is subject. If we assume the simplest case, or that of a vertical rocket, it is plain that it is subject, in a still atmosphere, to two counteracting forces only; namely, that of gravity, and that of the anterior resistance of the atmosphere. If therefore it could be retained in the vertical line without a stick, or any other appendage, it would ascend in a perpendicular direction. But it is subject to several disturbing forces which render it impossible for it to preserve that line. One of these is the wind; another arises from its own irregularity of form, which prevents it from meeting with an equable resistance on all sides from the current of air which it makes by its own flight, and the other and principal one is the perpetual variation of its centre of gravity which arises from the burning out of the composition.

If now a stick be attached to the lower extremity, and of sufficient length, parallel also to the axis, it is plain that at whatever instant it tends to deviate from the line of its flight, the rapid stream of air which is passing along parallel to the stick, will meet it on the opposite side and restore the original position. The case is precisely that of a rudder in a ship, similarly acted on by the current of water that runs along the keel, in such a manner as to produce the effect of restoring the true position wherever it may deviate; and further, in this particular case, of producing a new one when required, merely by causing the rudder to meet the current. The length of the stick is also necessary, partly to enable it to act with the greater effect on the passing current by its distance from the centre of gravity of the rocket, and partly to enable it the more easily to counteract or compensate that change in this centre which arises from the burning out of the composition.

In flights at low elevations, and at angles less than the perpendicular, the same reasoning, with some variations, is applicable. These are, however, so obvious that we need not enter on them. We must, however, remark, that the weight of the stick, in these cases, produces an effect which does not occur in the vertical flights. Its tendency is to make the rocket assume an angle of elevation greater than that at which it is placed on the frame. Thus, to produce a curve calculated for an initial direction of 45°, the rocket will require an elevation which may be only 42°, or even less. The explanation of this is easy. At the moment the rocket quits the support, its velocity is yet small; or the steerage way, to use a sea phrase, is insufficient to allow the rudder its full action. The weight of the after end of the stick thus causes it to drop, and consequently to elevate the rocket so as to increase the angle with the horizon. Hence the singular curves which are assumed by such rockets at the commencement of their flights.

From the action of the stick we can also account for the effects of wind in disturbing the flight of a rocket, and in altering the line of its direction; but we need not dwell on matters so obvious. But it is plain, that from the same great power which it thus possesses, it is most important, that in quitting the support, it should run clear: as the slightest impediment or irregularity that may affect its extremity, in particular, may produce very considerable deviations. It has been proposed to steady the flight of rockets by means of wings, so disposed, on opposite sides of the case, as to form the whole into the shape of an equilateral triangle. But this method is not efficacious, neither is it attended with any particular advantages in other respects. In the books it is also said that rockets may be steadied by a bullet attached to the end of a string at their extremity, which is palpable nonsense.

Of Line Rockets.

Of line rockets.

These are so exactly like sky rockets in their construction, that the same rules for filling the cases, and for the composition, are applicable to both. But as they are seen at a less distance, they admit of a variety of fire, which, in the sky rocket, is almost superfluous. This is the brilliant iron fire; and the artist may adopt, for this purpose, any of the strong compositions under the head of brilliant fires, or else that sky-rocket composition described in the table, for those into which iron enters. For the reader's convenience we may here give it again.

Saltpetre 8.
Sulphur 4.
Mealed powder 2.
Pounded iron or steel filings $1\frac{1}{2}$ part.

If lines can be stretched far enough, there need be no limit, as in sky rockets, to the length of the composition; but in no case is it necessary that the composition should burn longer than the line will admit, as it would at the end of its range remain stationary. Thus, as we have just shown that the average flight of a sky-rocket of one pound is 480 yards, 500 will be a sufficient length for the line. If it can be carried farther, an additional number of diameters of composition may be left above the bore in filling it; and it is easy by trial to compute the exact relative lengths of the line, and the nature of the composition, that this may be finished at the end of the range. We may also here remark, that the flight of a line rocket may be too rapid for the eye to follow it conveniently, particularly if it is a simple one, as it has very little resistance to encounter. In such a case it will be proper to reduce the length of the bore, which may easily be done by using a shorter spindle. But if the line rocket is to be compounded, or to carry any considerable weight, the artist may adhere to the usual proportions for sky-rockets. In all cases, it is easy to understand that the flight may be retarded by diminishing the length of the bore, or by increasing relatively the unbored part of the composition, in which case the effect is more pleasing than when the velocity is very great, but it is useless to give any positive rule on this subject, as the artist must be regulated by the length to which he can stretch his line.

The proper line for this purpose is that which is called jack-line, and it must be stretched as tight as possible, lest it should come too near the ground in the middle. Where simple, or alternating plain rockets that it may be strong when it arrives at the middle, so as to end in a lively manner. The remainder of the case is then to be filled with the same compositions in a reverse order. The case being then completely closed at both ends, as for the tourbillon, two holes must be bored into it at the extremities, and on opposite sides, that it may revolve like a wheel. To insure a sufficient velocity, if that is desired, each of these bores may also be prolonged according to the axis of the case, as in a rocket, but they need not extend inwards above a diameter. It must be primed by a single leader, that both ends may fire at once.

Fig. 9.

To arrange it for firing, it must be fixed on a short obtuse cone *a*, like a child's top, taking care that it be perfectly balanced, and that it may be spun like a top on the table where it is to be fired. When that is done it acts the part of a wheel on the table, with some little variety, arising from its lateral change of place. From the proximity of the spectators to such a firework as this, it will not well admit of terminating with a bounce. But it may end with a discharge of serpents. This is done by fixing a short thick case in the centre, with the opening directed upwards, which may be filled with serpents, and the requisite priming communicating by means of a hole with the middle of the firework. This case must not exceed an inch in length, lest it should overbalance the wheel; and the serpents, that must not be more than an inch and a half long, may be attached and retained in their place by a bit of thin paper pasted round them and the case together. These fireworks may also be made double, by fixing two rockets transversely on the cone, all the vents being directed the same way; and in this manner they succeed better, as the balance is more perfectly preserved.

Of Roman Candles.

Of Roman candles.

These are also known by the name of fire-pumps. They are very much used on all occasions of public display, as they are exceedingly ornamental; as well as on the most common occasions, by the people, and by school-boys. Though apparently simple, they are by no means easy to make so as to act well, and require therefore considerable attention, and very particular directions.

It is requisite that the cases should be exceedingly strong, as they have to bear considerable force without at the same time running any hazard of bursting. All the paper, therefore, which enters into the case, should be pasted at every turn, and well rolled, that it may be as hard as a board, and as strong as a piece of ordnance, which it is, in fact, as far as its use is concerned. Those who have frequent occasion to use this firework, for public purposes that recur often, will find it good economy to have iron cases as strong as gun barrels, which, of course, must be carefully cleaned and greased when out of use. The length of the case should not be less than twelve diameters; and as this firework, from its nature, cannot be very durable, it may even range as far as fifteen, if carefully made, beyond which the length becomes inconvenient, as the sparks have too far to travel through it before they make their appearance.

Before beginning to fill it, it is necessary that all the compositions which are to be introduced into it should be ready arranged under the operator's hand, as it is necessary to keep an accurate account of their succession and proportions. Four kinds of fire are all that can be introduced, but three at least are necessary. These are the common sparkling fire from charcoal; that from iron; the blue antimonial light; and the white light, the receipts for which may be selected at the operator's pleasure, from the table of compositions, with this recollection, that the sparkling fires need not be of a very strong kind, as there is no recoil wanted, and nothing but a stream of sparks. The stars for this purpose may also be taken from the compositions described for stars in general; but blue and white ones will be sufficient. It is requisite, however, that the stars used for Roman candles should be short cylinders, moulded in a case of the same dimensions, that they may take up as little room as possible, and run the least risk of being broken in the driving of the case. In point of thickness they need not exceed one quarter of the diameter of the charge, as it is a great object to save room, and as the star ought, if possible, to be burnt out before it falls to the ground. Thus we will here suppose, that the case is an inch in the interior diameter, when its length will be twelve inches, and the length of each star a quarter.

The case is closed at the lower extremity, and is filled from above; and as much force cannot be used, it may be driven without the precaution of using a mould. The first thing to be introduced is powder in the grain, to the amount of a diameter, on which is to be placed a star, or two or three, should the artist prefer it. But care must be taken that there be not powder enough to burst the case, as that would spoil the effect. If the artist is desirous that there should be a report at the end, it is better to attach a separate maroon, or a number of these, or else a folded cracker, which must communicate with the end of the charge, by a proper touch-hole.

On the top of the star must now be placed the amount of a diameter or more, of the brightest sparkling fire, which must be rammed down as hard as can safely be done, without breaking the star. But none of these compositions will bear so much driving as wheels or sky-rockets, for that reason. Another charge of powder, and another star, may then be introduced, and so on alternately, at the discretion of the operator; taking care to vary the fires as the firework proceeds, by means of the charcoal fires and the slow flaming compositions. But it is a general rule, that the brighter and stronger fires must be at the bottom, where the length of the case requires it, and that the slow ones should only be introduced high up in the case, as their flames would otherwise be half suffocated. The operator must also remember, that wherever a slow composition is introduced, it need not occupy so much space as a quick one; and he must also take care that one species of composition is firmly settled before another is introduced, that their effects on burning may be preserved distinct. With these attentions he cannot fail; and we shall only yet remark, that a twelve inch case may carry from six to eight or ten stars.

As this firework is transitory, its effect may be improved and prolonged in various ways. We shall describe a few of these. Many Roman candles may be fired together in a vertical direction; but, to produce a good effect from this method, all that are to burn at once must be so far different in the proportional distances of the stars in their composition, that there may always be a star or two in the air; a matter easily accomplished. Many may be made to fire at the same time in a different way, so as to produce a pleasing effect. In this way a number are arranged above each other on an upright post, at an angle of 50 or 60 degrees, and a similar number is placed in the same way on a post at some distance, so that their orifices are opposed to each other. Thus, when they are all lighted at once, as they must be by a single leader, they appear to carry on an engagement, throwing stars at each other, which, thus crossing, form beautiful curves in the air. In these contrivances also, the disposition of the stars should be dissimilar in the different cases, that there may be always a few stars in the air at the same time. We beg to caution pyrotechnists against suffering their stars to fall among the spectators, as they penetrate like musket balls, and as we have seen an instance of death from this accident.

As the Roman candle is not durable, and as it may be often desirable to keep up this kind of fire for a long time, this may be done indefinitely, even for a whole night were it required, by means of a succession of them placed together. For this purpose, they must be connected in succession by leaders from the end of one to the beginning of another, taking care that these may be so well secured that no accidental fire from one may discharge any of the chain out of its turn.

Single Roman candles may also be varied in other ways, independently of their combinations, with wheels or complicated pieces. Thus, they may be caused to discharge serpents as well as stars, by attaching these outside of the cases, and causing them to communicate with the composition at different periods of its burning, by means of a very small orifice. The serpent must, in this attempt, be secured to the case by a piece of quick match, which, by burning, will allow it easily to disengage itself; and thus, by making these holes in proper places, this firework may be caused to discharge a serpent and a star alternately. Crackers may also be attached to the sides of the cases in the same manner, so as very much to increase the effect; and it is further easy to make this more amusing by adopting the folded crackers which fly off, and continue their successions of reports after they are disengaged. Lastly, As the greatest defect of a single Roman candle is the quiet way in which it expires, it may be connected at the bottom with a separate magazine of stars or serpents, or crackers, or all united so as to terminate in a lively and brilliant manner.

Of Water Rockets.

Many kinds of complicated fireworks may be exhibited in the water without difficulty; a circumstance always surprising to the populace, who imagine a necessary antipathy between fire and water. But we shall only here describe the simpler water rocket, as the complicated kinds will come in a more proper place hereafter.

The principle of these is exactly the same as that of the sky rocket, or rather of the line rocket, as they require no sticks. The compositions may also be selected in the same manner, so that we need not dwell on this part of the subject. They should be furnished with bounces or crackers at the end, as it is to no purpose to provide stars or other ornaments, which would immediately be extinguished by coming into contact with the water. This cannot happen to the case, as the current of air issuing from it prevents the air from entering. But it is to no purpose to allow them to burn under the water, though they may be permitted to explode there with a good effect, as they only send up smoke, and appear to the spectators to be a failure when this happens. Hence they must be made just capable of floating on their sides, by means of a bit of cork or wood, if that is necessary. Thus, when fired, they recoil, and as this cannot be done in a straight line owing to the unequal resistance of the water, they wander about in serpentine directions, sometimes even sinking for a short space. It may happen that they will sink, and not rise again, by sticking in the mud, which must be considered as a failure; and as there is no advantage in this, we do not recommend the use of what is called a sinking charge.

If the water is large enough to afford room for a direct flight, this may be produced by means of a stick. That should be flat, so that at the extremity it may take a good hold of the water, and thus direct the steerage. If very long, the steerage will be so correct that it will advance in a straight line; but an irregular line, which is perhaps more amusing, may be produced by making the stick not much longer than the rocket itself.

The simpler water rocket may be caused to perform another motion, which is also entertaining. For this purpose, it is also to be provided with a stick, so formed, that when the whole is placed in the water, the rocket may lie at an angle of from five to ten degrees. In this case its mouth will be immersed; but that is of no moment, as a proper leader, well secured, to prevent the entrance of the water, must be brought from it towards the upper end of the case. When this rocket is fired, it rises out of the water, and falls again repeatedly so as to perform a ricochet-movement in its flight, or what is commonly called duck and drake.

It is possible also, and that without difficulty, if the water is deep enough, to fire the water rocket as a sky rocket, vertically. In this case, the stick must be counterpoised at the bottom by a bit of lead, so that the rocket may float erect, and as the mouth may be immersed, a leader must also be conducted from it upwards. Rockets so disposed, ascend with great force at first, owing to the great resistance offered by the water to the issuing stream of air.

Instead of single water rockets of a large size, many may be fired together; and in this case they are called squibs. These differ in no respect in their construction from ordinary squibs or serpents; only care must be taken that they may always float. In discharging them, some precautions are also required. The whole must be collected together on a piece of light-wood, by means of two or three stands of quick match, which, being burnt when they are lighted, they can easily disengage themselves, and wander about on the water.

If it is wished to fire large reports under water, these must be made in maroon cases of unusual size, and so heavy as to sink. A bit of squib or port-fire may then be attached to each, which is lighted when they are thrown in. This continues to burn under the water, however imperceptibly, so that the explosion of the cracker is somewhat unexpected and surprising, although the report is hollow, and as if suffocated. If very large, it produces a sensible shock on the surrounding ground. These crackers may also be floated, and exploded upon the surface.

We may lastly add, on the subject of the simpler water rockets, that Roman candles, gerbes, cases of serpents or of stars, or any kind of fixed cases that are used on the ground, may also be fired from the surface of the water by means of proper floats; but the method of doing this is so simple as to require no particular description, though we may remark, that large white lights calculated to burn for a considerable time produce a very pleasing effect in this way.

The simple water rockets may also be combined like the line rockets, so as to produce a more durable and various effect. Thus two or three, or many more, may be united in alternate order, so as that one may fire when the other is expended. But as the water permits of motion in any direction, we are not even limited to this regular order. Thus the cases may be put together in any disorderly manner that the operator chooses, and the effect of this will be a great variety of intricate serpentine movements, so as to increase very much the effect; the greatest objection to the water rocket being its want of variety and brilliancy. If they are attached in the form of a wheel, so as to float on the surface, they will also produce a pleasing appearance; but the artist must not expect that they will revolve regularly like a wheel in this manner, because of the very unequal resistance which they meet with from the water in the attempt to revolve. To make a wheel revolve upon water requires a proper contrivance, which must be sufficient to float whatever wheels may be used. We shall describe under the head of *Wheels* all the kinds, so that the artist may select from them any which he may think proper.

Of Gerbes.

Of gerbes.

Plate CCCCLXXII. Fig. 10.

This is the most brilliant of all the fixed simple fireworks, being formed entirely of the iron fire. Various receipts for it will be found in the table of compositions, so that we need not here repeat them. We must, however, remark, that in proportion to the dimensions of the gerbe may be the size of the particles of iron. Thus the largest fragments of cast iron may be put into cases of three or four inches in diameter, while steel filings may be used for the smallest. The proportion of three pounds of mealed powder to one of iron will be found to answer generally as a rule.

There is a peculiarity in the construction of the cases for the larger gerbes which requires to be described. They should be extremely strong, as the composition, which is very powerful, and requires to be much checked at the issue, might otherwise burst them. But besides the ordinary choke, they must be provided with a second at some distance, and as this is somewhat difficult to manage in paper, it is better to have a vacant space in the case above the choke, which is to be filled with a wooden tube, well glued, and secured in it; the diameter of its bore being the same as that of the choke itself. This may be about two inches in length for the cube of three or four inches in diameter, and so in proportion; the smallest sizes requiring nothing more than the ordinary choke. The purposes of this long aperture is to enable the iron to be completely heated in its passage out, without which precaution the larger kinds might be thrown out unburnt; and also to compel the sparks to spread after their issue, so as to produce that resemblance of a wheat sheaf whence the name is derived.

The filling of such a case requires some precautions; and, on account of the great force required to drive it firm, a mould is necessary. The length may vary from four diameters to ten or more, according to the views of the artist respecting its duration. When placed in the mould for driving, with the mouth downwards, a plug of wood must be put into the vent so as to fill it up. Half a diameter, or a whole one, of a moderate charcoal fire must first be introduced, that the firework may not break out in all its brilliancy at once, after which it may be filled to the end with the iron composition. If a bounce is required it should be in a separate maroon case, as it is more manageable and louder; and, from economy, as the gerbe case may serve a second time with the addition of a new vent. The driving requires to be performed with as much force as it is possible to give; fully as great, or even greater than for rockets of the same size; as the strength of composition necessary for burning the iron effectually is so great, that, if not well driven, it would burst the case. The larger gerbes, indeed, can scarcely be effectually driven without the pile engine. When finished, it is advisable to fill up the neck with a blue light or other composition of little show, as the surprise will be the greater when the gerbe comes to take fire.

The smaller gerbes are sometimes called fountains and Chinese fires, but they differ in no respect from the former, except in size and in the nature of the composition, as already noticed. We mentioned that a common choke would answer, if on a very small scale. When they amount to six or eight ounces, however, a better way of making the choke is to drive a diameter of clay first upon it, which may, after the composition is driven, be perforated by a gimlet of the proper size.

In the books of pyrotechny, receipts will be found for making what is called the Chinese spur fire, which are purely imaginary. This is said to be a cold fire, (not a very intelligible term,) and to be made with saltpetre, sulphur, and lamp black. One of the receipts gives four quarts of lamp black to a pound of saltpetre and half a pound of sulphur; a composition which may well be called cold, as it would not burn at all. The truth is, that the Chinese spur-fire, sometimes also called flower pots, is merely a gerbe; and the bright sparks are produced in the usual way by iron. But as the Chinese are great economists in their materials, these are made on a very small scale. The composition is simply that of gunpowder, or of saltpetre 75 parts, sulphur 10, and fine charcoal or lamp black fifteen, by weight, well mixed and rammed. A very few grains of iron are introduced at different distances into the composition during the driving, so that instead of yielding a torrent of sparks it gives a red strong flame, with an occasional bright spark. No other directions can be required for making this flower-pot, which is generally made on a very small scale, so as to admit of being fired, like the fire wheels, and all the other Chinese fireworks, in a room.

We shall not add any thing here respecting the various additions that may be made to gerbes, as it would be in a great measure to repeat that which has been said on this subject in other places.

Pots de Brins. Pots d'aigrettes. Pots de Saucissons.

There are three kinds of fireworks described in all the books of pyrotechny, but as the general principle is the same in all, and as there is indeed no great difference among them but the name, we have here classed them all together.

The pots de brins, as they are called, are intended to throw serpents, stars, and crackers; the pots d'aigrettes throw serpents only, and the last kind is intended to throw up cases which are half serpent and half cracker. These admit of no other variety but in their size; and the management is the same for all.

To make a single case of this kind, it must be of sufficient strength to resist the explosion of the powder, and that is all which is requisite, as no choke is wanted, and as they are closed at the bottom, and require no driving. They must be considered, in fact, merely as mortars or pieces of ordnance; and, if of large size, and likely to be wanted again, it is better that they should be made of metal or wood. They need not be much longer than the cases which they are to contain, if they are intended to fire serpents; but, if to throw stars, the length will depend on the views of the operator.

The smallest sizes are used by the Chinese to throw serpents, and these serpents do not exceed the sixth of an inch in the interior diameter. A case of three inches in diameter, and two inches in length is sufficient for these. But as serpents even of four ounce dimensions may be thrown in the same way, the sizes must be increased accordingly. In loading them, a small quantity of mealed powder, not above a quarter of an inch in thickness, must first be laid on the bottom of the case, and rammed down tight, to prevent it from being shaken in the carriage. Upon this the serpents are to be placed with their mouths downwards, and so that they may not be too tight in the case, which would prevent them from flying easily out. As these have sufficient force of recoil themselves, they do not require a large charge in the case, unless it is intended to throw them very high into the air. Should this be desired, the case must have a load of powder in grains first; on which is to be fitted a loose cover of pasteboard to serve as a wadding. Above this must then be placed as much mealed powder as will be sufficient to inflame the serpents; and thus the desired effect will be obtained. The same rule may be attended to, if saucissons, or crackers, are to be used instead of simple serpents. But we must here caution the artist against making these too long, as, if they are, they will overset and fall down. Five diameters are quite sufficient, and even less may answer.

If stars are to be projected, either alone, or with serpents and crackers, a sufficient charge of grain powder for the intended purpose is also required; and it is to be managed in the same manner. To prevent disturbance in the carriage, the pasteboard division or wadding may be pasted at the margin slightly to the case, by means of a bit of thin paper; but it is a general rule to avoid oversetting these fireworks in the carriage, as the mealed powder might get into the chokes of the serpents, and cause them to burst in the cases. For stars, this is of no consequence. It may indeed be preferable generally to keep these cases filled, all excepting the mealed powder, which may be introduced just before the time of firing. In this way, the paper which is to cover and secure the serpents, must be pasted in a cylindrical manner round the case, so as to be twisted up at the top loosely. Otherwise it may be fastened down like the head of a drum; but in every way it must be made slender, so that it may easily blow up.

Such cases as we have now described, if used alone, may be fired by a leader of quick match inserted into the top, and furnished at the extremity with a bit of slow match, so as to allow the operator time to retire. But it is usual in public displays to fire many at once; in which case all the leaders must communicate with a common one, which may also be conveniently attached to some case of ordinary fire that may burn first, and thus give time.

It is farther easy to see how these may be united to Roman candles, or gerbes, or white lights, or any other class of fires. But for this purpose they must all be fixed together in frames; and the leaders, which are to communicate to the pots of serpents, should enter by a hole at the bottom. A conical, hard, but loose cup should also be placed over the mouths, to prevent any chance of a spark falling into them and inflaming them before their time. All these pots may be used in the water by means of proper floats, and the serpents when thrown on the water have a good effect if they are made light enough to swim.

Of Balloons.

Of balloons.

These are contrivances for carrying squibs, or serpents, or stars, or crackers, high up into the air before bursting. Being thus dispersed from a single point, they produce a strong effect. Directions have already been given for making the cases, and those for the fuses will be found under the head of military fireworks. A sufficient quantity of powder must be introduced to burst the shell and inflame the contents, and the mortar used to fire them must be regulated in the same way to throw them as high as may be desired.

Balloons may also be used upon the water; but without any particular advantage. It is recommended in the books of pyrotechny to sink them under the water and inflame them by means of a projecting case. But so far from any thing being gained in this way, the contents will be half lost by sinking in the water. This is one of the schemes so common in the books on this art, which seem to have been entered among others without any consideration.

Single Crackers and Maroons.

Single crackers and maroons.

These are an essential part of all fireworks, and may be attached in various ways to other kinds of cases, as we have already suggested. The one or two-ounce case, is sufficiently large for ordinary purposes; but crackers may be made of any dimensions which the operator may think fit. The length may vary from two inches to four, and the cases must be unusually strong, as the effect depends entirely on that circumstance. They must be filled with grain powder, pressed in, but not bruised. When full, the cases are to be choked at the upper end in the engine as closely as possible; introducing a bit of wood at the same time to preserve a touch hole. They are then primed with a bit of quick match, fastened in by a bit of pasted paper, when they are ready to be attached wherever they may be wanted.

This is the practice for crackers that are to be fastened to other fireworks. But if they are required to be thrown out of pots or mortars, about a diameter of the case above the vent must be left unfilled when it is choked. Into this a slow charcoal composition is to be introduced, and rammed firmly down, that it may burn for a second after the cracker has been thrown out, so as to allow it time to explode in the air; and no priming is required in this case, as it is lighted by the blast of the explosion.

When crackers are required for separate firing, and merely for the sake of the reports, they are made much stronger, and are then called maroons. The case being filled in the same manner as before, the ends of the folds of paper at the open part are turned down upon the charge in succession, and pressed firmly on it with the aid of a little glue, so that it is entirely closed. It is then covered with numerous turns of waxed twine and paper in succession, till it becomes a ball as strong and thick as the operator chooses. The loudness of the report depends on this circumstance. As maroons are generally used for the purpose of firing salutes, they must be connected together to the requisite number, and in such a way that they may fire in succession without the risk of disabling each other. To do this conveniently, a priming hole must be bored in each with a small gimblet, and a piece of quick match inserted and properly secured in a paper tube, tied on with a string and pasted paper to the maroon. A single leader is then made, so as to burn for any length of time that the operator pleases, that a sufficient interval may be allowed for the explosion of each cracker. This must first be well secured to a wooden frame by nails or twine; and holes being then made in it at proper distances, the leader of each maroon is fixed to one of these by a sufficiently strong joint of pasted paper. The most convenient way is to allow each maroon to hang loose by means of its own tail or leader from the main conductor. Thus, when this is fired, each maroon is detached in succession as it explodes, so as not to burn or disturb the rest; and thus the whole may be caused to make their reports at very regular intervals, provided the main leaders be well made. The match for this leader must be intermediate in quickness between slow and quick match, and is easily made by a mixture of three parts of saltpetre to one of charcoal; or else the leader may be filled in the manner of a case, with a charcoal composition of moderate force, which may be rammed down sufficiently hard without a mould, by means of an iron wire. The leader case must not be too strong if it is of any considerable length, that it may burst occasionally without much effort, at each joint or thereabouts, so as to give vent to the fire without any disturbance.

Crackers and maroons may be attached to all sorts of cases, such as line rockets and water rockets, by means of leaders properly inserted into them at the periods when it is wished that they should take fire.

Of Compound Crackers.

Of compound crackers.

These are the most amusing of the tribe, but are rather considered vulgar by the great pyrotechnists. They are, however, very convenient for attaching to other fixed fireworks of various kinds, as well as for blowing out of mortars; as they produce a great many reports at less expence and less trouble than can be done in any other way. This firework nevertheless is not very easy to make well.

The cartridge paper intended for it is to be about four inches broad and a foot long, as that is as much as can conveniently be folded at once. Being folded with one fold a quarter of an inch broad, a train of powder is to be laid along the groove thus produced, when the paper is to be folded over until it is entirely enclosed, after which the ends must be turned over, and beat down, to prevent it from running out. The tube must not be too full, or it will crack in the bending. When bent, this is done alternately backwards and forwards at distances of about two inches or more. The middle of each bend is then to be secured separately by a strong twine, and a half hitch or two, in the choking engine, so that the communication between each joint may be as much cut off as possible, without which two joints might only make one report. Each place where this choke is made, should also be firmly beat down with a hammer, to bruise the powder, and check its velocity, as otherwise the several reports are apt to follow too quick upon each other. After this, every turn is to be fastened to the next, with the same twine, and the whole finally brought together in the choking engine, so that it may be as much compressed in the middle as possible. As each bend makes one report only, there can only be five or six in a foot of paper, and it is often desirable to have many more. But as it is scarcely possible to fold up more than a foot of paper at a time, it is better to attach two or three, or more, if the operator thinks fit, together. For this purpose, the cut end of one must be inserted into the other, together with a bit of quick-match, and the two tubes connected with pasted paper; after which, by means of more twine, the whole are formed into one mass. Lastly, a proper quick-match leader must be tied with twine into one of the ends, for the purpose of lighting it.

These crackers may also be made, and somewhat more easily, in tubes pasted up in the usual manner; and in this way they may be made of any length at once by the following process. Care must be taken in the first place, that the tube may be flattened on a flat stick from one end to the other, so as that it may hold but a given quantity of powder, and that this may be distributed as equally as possible through it. If there is too much powder, it will crack in the binding; but the artist will soon discover how much a case like this will bear. To bend it without disturbing the charge, it must next be tied down to a stick, in a horizontal position, by bits of twine at each place where there is to be a turn. Thus it may be bent and secured in succession as often as is necessary, without the risk of displacing the contents; a string being passed round it, separately from the stick, so as to choke each joint completely, before any attempt is made to bend up the different turns.

We remarked formerly, that these crackers may be attached to any kind of fixed or moving cases, such as a line rocket or a Roman candle. But as the principal amusement which it affords arises from its breaking loose among the spectators, it must be attached so lightly by its leader, that it may easily disengage itself at the first explosion. We may add, that the breaking loose of these in this way, while it is amusing, is attended with no danger; whereas serpents, which excite less alarm, are exceedingly dangerous, as they are apt to set fire to women's dresses. They ought never, therefore, to be allowed to fly among a promiscuous crowd.

Of Scrolls.

This is a pleasing ornament, either for sky rocket heads, or for the purpose of discharging from pots or mortars on the ground. Indeed, they are chiefly calculated for this latter purpose, as their difference from a serpent, in point of effect, is not very sensible at a great distance, although sufficiently visible when near at hand. In effect, it is a sort of tourbillon on a small scale, but provided only with a rotatory motion.

The cases may be from four to six inches long, and the interior diameter half an inch. They must be filled with a lively composition, either of charcoal or iron, and driven hard in a mould. The open end of the case must be then beat down hard, and secured with glue in the manner often mentioned before. When they are thus far made, a hole must be bored at each end of the case, on opposite sides, a semidiameter in breadth. They require no priming, if care be taken that the holes are free. But if they are to be thrown out of cases that do not contain much exploding powder, it will be safest to insert a bit of quick-match into the upper hole, or that most distant from the charge.

A bounce may also be combined with this simple scroll, but it is then necessary to give it at least a diameter more in length; and the middle of the case, for the length of a diameter or more, must be filled with gunpowder alone.

Rains.

This is a kind of ornament mentioned in all the books of pyrotechny, but the effect is so very little different from that of a serpent, that it scarcely requires notice. The cases for these are not choked; whence the difference in the burning is, that they do not serpentize as the choked cases do. In sky rockets, they thus descend in straight lines to the ground when discharged. Hence it is that they are less useful for fixed fireworks, as they are apt to fall to the ground before they are expended.

They must be driven hard in moulds, and need not be above four diameters in length. But, as when used for ornamenting sky rockets, it is desirable that they should carry their fire all the way to the ground, they may be timed so as to burn all the while they are falling. This is easily done; because the time of descent of the rocket stick, or of these ornaments, is as nearly as possible the same as that of the ascent; or, for a pound rocket, about twelve seconds.

In making these, the fire may be varied; so that one part of the case is filled with a brilliant composition, and the others with a white or blue light. The artist also has it in his power to vary the effects, by causing either the one or the other of these to burn first. They may also be provided with a bounce at the end, in which case they come under the following division.

Of Saucissons.

These, improperly enough named, are compounded of a brilliant fire and a bounce, and are of use only for discharges out of mortars or pots fixed on the ground. They may be made two ways, either in choked or open cases. The cases may be about four inches, or from four to six inches, or even more in length, and the diameters from three-eighths to one-half of an inch. The cases must also be strong, and they require to be driven in moulds. If they are to be choked, the brilliant composition must be driven in first, and so as to fill half the case. The case is then to be choked above it upon a small wire, so as to leave the least possible opening of communication to the powder with which the remainder of the case is to be filled. This must be pressed down but not rammed hard; and the end of the case must then be turned in with glue, or else choked quite close upon a cylinder of paper. If they are to be open in the mouth, which must be done if they are to burn a blue or white instead of a brilliant light, the powder may be introduced first, and then choked to a small priming hole as before. The case is then to be returned into the mould, and the composition rammed in hard. In this way, there is no danger of bruising the powder, as the choke protects it from the force of the rammer. If the composition is to be a white or slow one of any kind, it need not occupy so large a part of the case, and the powder may be allowed proportionally more room.

Of Illumination and other Lights.

Of illumination and other lights.

These are very important in all fireworks, as well on account of their intrinsic beauty, and of the variety they afford among other fires, as because of the number of uses to which they are applied. As they burn very slowly, they may be made to last a long time by using long cases; or what is better, by firing different short ones in succession.

One of the chief uses of these lights in fireworks on the large scale, is to illuminate transparencies, as we formerly noticed in treating of this department of pyrotechny. When they are to be used for this purpose, a sufficient number of cases calculated to burn out the whole duration of the firework, however long that may be, must be arranged on a proper board, well secured, with a leader, passing in succession from the end of the preceding to the beginning of the following one. For such purposes, if it is the front of a piece of architecture that is to be lighted, the cases also should reach from three or four to six or eight inches in diameter. In other works, they are proportioned to the sizes of the pictures, as in illuminated guns, or coats of arms, or crowns, and other emblems commonly used in public exhibitions. For small Chinese transparencies, as lanthorns, dragons, and such like objects, they are very small.

They are often used to terminate buildings, or other large complicated exhibitions of fireworks, when they may surmount turrets or columns. Thus also they are introduced into a variety of complicated fireworks that will be described hereafter; and in these cases, they are exposed to view. These are always necessarily of a large size. We have already mentioned their uses in sky-rockets, and they may be floated on the water so as to become a kind of water-rocket.

With respect to those larger kinds of lights, different compositions are found in books of pyrotechny. But the only three worth preserving are those formed with orpiment, with zinc, and with antimony. Receipts for all these will be found in our table of compositions; but we have introduced into this article, for the reader's convenience, those which we think may supersede all other contrivances of this nature, namely, the zinc light and the antimonial one, the former being of a bright white, and the other a beautiful pale blue. No particular attention is required as to the cases, as it is sufficient if they are barely thick and strong enough to retain the composition. It is rather an advantage that the case and composition should burn together, as the white of the light is thus better displayed.

The smaller illumination lights, commonly called speckies, are even of more consequence than the large, as no complicated ornamental firework can be made without them. It is by means of these that crowns, inscriptions, and figures of all kinds are made. By these also, all the architectural lines in a piece of architecture in fireworks are defined. Entablatures and basements, columns, windows, and door-ways, are produced by lines of these lights, which must be disposed at distances, varying from six inches to a foot, according to the expence which is admissible, and the effect which it is intended to produce. In the same way spirals are formed, together with cones, globes, pyramids, and other mathematical figures. Thus also they are applied to moving figures, such as revolving cones, or globes, or wheels; the motions of these being sometimes produced by machinery, at others by means of attached recoiling fireworks, as formerly mentioned in treating of machinery in fireworks.

In smaller works, these lights may be applied to the central parts of wheels, so as to form concentric circles of light during their revolution; or they may be attached to sky-rockets, or to line-rockets, as was suggested on former occasions. The mode of managing these requires no particular direction; as the same methods of lighting, of disposing, and of connecting them are applicable to all.

But it will not be amiss to mention, though at the hazard of some repetition, the precautions and cares which these very important fireworks demand; whether made simply of a light only, or whether provided with crackers or reports at their termination.

A considerable number of compositions are given in our table of compositions, whence the artist may select different colours so as to vary the effects, all of which must depend on his own taste, and on the nature of his projected design. It is extremely necessary, as we formerly remarked, that all these compositions, of whatever nature they may be, should be very firmly powdered and intimately mixed; as their correct performance depends in a great measure on this, and that all those which are to burn together should be filled from the same lot of composition, and by the same hand.

The cases for these must vary in size, according to the magnitude of the firework into which they are to enter, and the distance at which it is to be viewed. A length of three inches by a diameter of half an inch interiorly, is as small as they can well be required for making figured illuminations, such as those now under review; and from that they may be extended to double the dimensions and upwards. These cases must all be driven in moulds, without which it would be impossible to give them the requisite uniformity; and this is done with the bottom downwards, as they are not choked for burning. If they are to be provided with crackers or bounces at the end, that must be managed in the manner not long ago directed for saucissons; but the cases for this purpose must be half as long again; and that part which contains the bounce may also be fortified with some additional turns of paper, and of packthread if the artist thinks fit.

To make these illumination lights ready for firing, they must be nailed firmly down to the frames by means of proper flat-headed nails fitted to this purpose; or else they may be secured in sockets of tin fitted to the frame-work, or to iron hooks by means of packthread. When thus disposed in their proper order, the leader is to be attached to the whole in one continuous line, taking care that every light has a fair communication with it; and it must be secured at each joint by means of pasted paper, to prevent the hazard of any accidental spark firing the lights before their time. This, however, must neither be so thick nor so firmly fixed but that it may blow off and disengage itself as the case fires; lest in so doing it should disturb any of the lights to which it was attached. If there is a great or long range of these to be fired at once, it is better not to trust to one place of firing, on account of the time taken for the fire to communicate through a very long leader. Two or three points at equal distances should be selected in the line of communication, and a leader being attached to each of these, they must all be collected together into one common point for firing. Thus the fire will be more equally distributed, and the whole range, however long it may be, will be lighted together. This precaution is particularly necessary where it is a large building that is to be illuminated; and unless it is attended to, one part will go out while the rest is continuing to burn; a circumstance which always produces a very disagreeable effect.

We shall here subjoin the compositions which we consider the best for the larger lights, referring to our table of compositions for those which are in use among the pyrotechnists.

White Lights from Zinc.

Nitre	8 lb.	1 oz.
Sulphur	4	0
Mealed powder	2	2
Zinc filings	3	0

This light is used for white speckies, or illumination lights in ornamental fireworks.

White Lights from Zinc.

Nitre	8 lb.	12 oz.
Sulphur	4	0
Zinc filings	2	0

This is used for large signal lights, being inclosed in wooden tubes or pots, or in paper cases, or in iron pots, varying from one to six inches in diameter, and from four inches to a foot in depth. The illumination is very powerful.

The same composition, being driven as hard as possible into a globe of strong and thick pasted paper, sufficient to bear the explosion of a mortar, is thrown into the enemies works at night to discover what they are doing. The ball or paper carcass should have three holes of an inch and half diameter, each furnished with a quick match and priming of powder, well secured by a pasted paper cover.

Pale bluish Lights.

Nitre	8 lb.
Sulphur	4
Mealed powder	2
Zinc filings	1
Antimony	2

This is adapted for small lights. If large lights are wanted, the powder may be omitted, and the composition be altered as follows.

Nitre	8 lb.	12 oz.
Sulphur	4	0
Zinc filings	1	0
Antimony	2	0

Of Stars.

These are an essential ingredient in sky rockets, in Roman candles, and for explosions from mortars; and as they produce very brilliant effects, they deserve the care and attention of the artist.

A necessary property of all stars is, that they should be hard enough to bear the explosion of the powder which is to set them on fire, and that their light should be bright and showy. Hence, although we have given some of the least exceptionable of the usual receipts for them, we do not recommend any but those from antimony and from zinc; the former of which burns with a blue flame, and the latter with a white one. We select the following as that in most general use, and as sufficient for most purposes.

But besides these stars, which are made up naked, they are sometimes made in paper cases, which must not however consist of more than two turns of paper, and which are open at both ends. The use of this contrivance is to protect them from the violence of the explosion, when fired out of pots or mortars.

Stars may be strung together in chains by passing a strong piece of twine through the middle of a great number while they are wet, or rolling them upon the twine. By means of this contrivance, they do not at first disperse when exploded; but as this happens almost immediately afterwards from the burning of the twine, the effect gained in this way is very transitory.

There is a variety mentioned in the books called tailed stars, and which are said to show a tail of sparks "like a comet." This is one of the fictitious inventions in which all these books abound, and which seem often to have been put down by guess. We think it right to mention the names of a few of these, partly that our readers may not think that we had forgotten them, or were ignorant of them, and partly as a caution to the inexperienced who, in following such directions, can only lose their money and their labour. It is impossible to cause a star to show a tail of sparks, as a case is requisite for that purpose; and if there is to be such a train of fire, it is no longer a star but a squib.

Stars for Sky Rockets and Roman Candles.

Mealed powder	5 lb.
Sulphur	8
Nitre	16
Antimony	2

This composition must be made into a paste, with a solution of gum arabic. It may be rolled into balls about the size of a pistol or musket bullet; or what is better, it may be forced into metal cylinders formed of two longitudinal pieces. When dry, it can be cut into convenient lengths. It must be of a stony hardness when dry, or it will not bear the force of the explosion. If there is too much gum, it is apt to miss fire. Isinglass, dissolved in spirit of wine, is recommended in the books; but it will not dissolve in that fluid.

Serpents for Sky Rockets.

Many compositions for this purpose will be found in the table, but the present one answers as well as any: it is as follows:—

Nitre	3 lb.	0 oz.
Sulphur	2	0
Charcoal	0	8
Mealed powder	16	0

This is rammed into paper cases of about three lines in diameter, made with three folds of cartridge paper, the last turn being pasted. In the further end there must be some corned powder for a cracker. But the best way is to choke the case first, as for sky rockets; then to drive in the composition till it is three quarters full; after which it is to be choked above the charge still closer, and then filled with loose powder. After that it is choked quite close, and secured at the top, the serpents are placed in the rocket head with the mouth downwards, upon the requisite priming. The same is done if used for fixed discharges of serpents. In these there is no limit to the number that may be used at once, and as they may easily be placed in any part of a complicated firework, the effect is very lively and ornamental. When used in this manner, the paper cases must be made very strong at the sides and bottom, and covered with a weak cover above, that they may get out easily. A little powder is placed in the bottom of the case, into which the open ends of the serpents are plunged, and there is a touch-hole bored near it, through which the quick match of the leader is introduced. The lengths should not exceed three inches for the largest diameter, or else they are apt to overset and fall to the ground. In sky-rockets, however, their lengths may be unlimited.

Serpents not exceeding two inches in length, and a quarter of an inch in diameter, may also be made of powder alone; but it must be rammed hard, in a wooden mould. The case requires no choke in this instance, so that it may be filled at the mouth. The Chinese serpents are made in this manner; and if furnished with a very slender and straight splinter of bamboo, or fir, they will ascend like sky rockets, vertically. As they occupy very little room, even with the sticks, flights of them may be easily introduced into such ornamental fireworks as are not to be viewed from a great distance.

But serpents may be made of a much larger size than this when large sky rockets are used, or when they are to be discharged from powerful mortars, or exploded out of air balloons. They may also be used of large size for the most common purposes, as for small pots on the ground, or for being attached to gerbes, or to line rockets, or to be used as water rockets. There is in fact no limit to them, except the comfort and safety of the spectators, among whom they are apt to fall when the crowd is too near the place of exhibition. The operator will of course be guided by this circumstance; as accidents by which persons may be injured are in every way blamable and discreditable to the operator.

For such large sizes the cases may go as far as eight inches in length, or to the size of a quarter of a pound sky rocket. These must be filled with a sky rocket composition, and bored in the same manner, and they must in fact be considered as sky rockets without sticks. When of large size, they are very violent in their motions, and hence the caution which we have just given against using them in crowds, or near to spectators.

Whenever serpents become large, their flight is very much improved by adding a stick to them. This need not exceed one or two lengths of the rocket, but the longer it is, the more nearly will the serpent become a sky rocket in its flight. The effect of those with sticks is good, when used on the ground, as by this means they ascend to a considerable height before they begin to serpentize. They are not difficult to manage, as the firing case may easily be made long enough to imbed the sticks, as far as to the mouths of the serpents. But in this case a quick match from each must be let down upon the exploding charge; and the whole of the serpents may then be collected above, by means of a slight piece of pasted paper, into a cylinder and cone, so as to protect them from all injury till the time of using them is arrived.

Having thus finished with the simplest class of fireworks, we shall proceed to wheels, as first in the order of complication.

Of Wheels.

Of Wheels.

These, in all their varieties, form the most showy and amusing kind of firework in the whole catalogue, and one which is in many respects much cheaper than others of less brilliancy. All of them depend upon the principle of recoil, until they become much complicated and intermixed with other works, so as to be required to carry additional weight; when the assistance of revolving machinery becomes necessary, as we formerly suggested. In their next simple state they admit of considerable variety, depending on their dimensions, their velocity, and the quality of their fires. But they also admit of so many modifications, by which they pass gradually into the second class of complicated fireworks, that we must treat of each variety under separate heads.

It will be necessary here to repeat some of the general remarks formerly made, with the addition of others, for the artist's government. Where they are to move by their own force, the cases require to be choked and driven just as for rockets. But it is not often necessary to bore them, unless a very great velocity or force is wanted; in which case they must be driven on the spindle in the usual manner. Supposing that a wheel, formed of cases, an inch or more in diameter is wanted, as there is a considerable weight to be brought into motion from a state of rest, it may be necessary to make the case, which is first intended for lighting, with a long bore, or to make it, in fact, a sky rocket. Thus, there will be gained so great a velocity at the beginning, that a very small additional force in the successive cases will be sufficient to maintain the motion to the end. The second and third cases may, therefore, pass without boring, or even the whole; or else a short bore, varying from one diameter to two or more in length, may be used; or, lastly, the cases may alternately be bored or left solid; but on all these points it is only necessary to give the general principles, as the artist must after all be guided by his own discretion, and by the nature of his particular views.

The cases for wheels must be as strong as those for sky rockets, as they have to bear a considerable force, in consequence of the strength of their charges. Nor is the weight any objection: on the contrary, when once it is in motion, a heavy wheel acts better than a light one, because it does not easily lose the velocity which it has acquired; but, acting like a fly wheel, maintains during the burning of any slow part of the composition which may be introduced, that motion which it had acquired from a stronger one. These cases need not, however, be limited in length as those of rockets are, but may be made of twelve diameters, or even more. But a foot of length will be found a very good general rule for a case whose interior diameter is an inch.

When driven, a little clay may be laid on the mouth, if the artist thinks proper, to preserve the choke from being burnt; and if this is done, and the cases are sufficiently strong, they will admit of being used a second time. The ends are to be left open, and no bounces are to be admitted, as they would be apt to derange the wheel, and throw it off the spindle. If a bounce is wanted at the end, which may be desirable, it can be attached loosely like a maroon to the last case by means of a leader, and laid upon one of the spikes, so as to disengage itself when it takes fire, without injuring the machinery. The same may indeed be done more extensively, as we shall hereafter notice in treating of hexagonal wheels.

In filling wheel cases, three or more compositions may be used, and for the nature of these we may refer to the table. But we will here suppose that three have been selected, namely, an iron sparkling fire, a common charcoal one, and a blue or white flame. A diameter of the case or more, near the mouth, must be laid with a strong charcoal composition, and that is to be followed by the same quantity or more of a brilliant one, which may again be succeeded by a blue or white flame, and so on alternately, as the taste of the operator may direct. It must be remembered, however, that the flaming compositions should never be placed far away from the mouth in the cases, as these flames will not reach very far, and might be suffocated or burnt out within the rocket, instead of showing as they ought to do. The artist must also recollect that half a diameter of any of these will be sufficient, as they burn comparatively slow; and as their force is very small, they might, if they lasted too long, retard the motion of the wheel inconveniently. Whenever there is any fear of this event happening, a strong one must be made to succeed, for the purpose of recovering the velocity.

The artist must now, however, recollect, that if a case is to be bored, no such changes of the composition are admissible; as the bore would render all this useless, by causing the different kinds to burn together. In such a case, any one composition must reach at least to half a diameter beyond the bore, after which a change is admissible.

The last general direction applicable to all wheels alike, is the fixing and priming. Supposing the case of an hexagonal wheel, as applicable to all, the rockets must be tied on the circumference with strong twine, which is afterwards to be covered with a turn or two of pasted paper. Great care must be taken that they are placed in the plane of the wheel, so that no force may be lost, and that they are placed in succession so that the choke of one is next to the end of the preceding. A whole diameter of the case must also be left between each pair, that the fire may flow freely without meeting any obstruction from the end of that last burnt. This being done, a thick strand of quick-match must be introduced between each head and tail, and fixed in both; when the joint must be secured with pasted paper. This should not, however, be made too strong, to prevent the wheel from being shaken by the explosion which takes place at the lighting of the cases. Lastly, a long leader is to be fixed to the first, and being reserved closed, it may afterwards be cut to the proper length, and affixed to any firework which it is intended that the wheel should follow.

Of Single Case Wheels.

These are extremely convenient for attaching to other fireworks, where there is little room to spare, or where much weight cannot be carried; and, from their acting at two orifices at once, the effect is very good. They are, however, of very short duration, so that they are not fit to be used alone. In the Chinese drum they are indispensible; as the necessity of packing close renders any other kind of wheel scarcely admissible. They may also be attached to line rockets, and to many other classes of fixed and moving fireworks; but we need not give particular directions for these uses, as a dexterous artist will easily learn to avail himself of the advantages which they offer.

Wheels of this construction may be made of all sizes, from two ounces upwards to a pound or two; and the cases must be as strong as those intended for tourbillons, as they have a considerable force to bear. This wheel indeed bears a resemblance to the tourbillon in every thing but the central holes, and is exactly the scroll formerly described, with the addition of an axis and centre. They may, however, be made of double the length of cases for all other purposes, or of any length from eighteen to twenty-four interior diameters. Thus the half inch wheel will be a foot long. If more, they will still act well, provided that both orifices are fired together.

In driving them, a mould must be used; as the same hardness and regularity of composition are required as in the tourbillon. The compositions may also be varied, as was described just now for hexagonal wheels; but in doing this, if the wheel is a simple case, perforated at both ends, the artist must recollect that whatever composition is placed at one end, the same ought to be placed at the other; but in a reverse order, so that the circle of fire may be uniform. Yet a variety is also admissible, by entirely reversing the quality of the composition at opposite ends; so that while one orifice is producing a sparkling fire, the other may give a blue or a white flame. We need scarcely add, that the compositions may be selected from the table at the artist's pleasure; but as this wheel is so short and light, that little force is required to put it in motion, the operator need not be anxious about using strong fires.

In driving this case, one end must first be choked quite close; or, what is better, the ends of the folds should be turned in with glue, and beat down square and solid, so that there may be as little unnecessary length as possible. The centre of the case must then be measured and marked upon the case and rammer both, and half a diameter must then be laid down upon the latter, on each side of this line. Thus, when the artist has arrived at this point, he will have notice, without farther trial, that the first half of the case is filled. Clay is then to be introduced and beat down with the same degree of force, so as to form one diameter. In the larger cases, indeed, less will answer the purpose, as the only object of this is to form the centre through which the axis is to be inserted. This at least is the common practice; but we have found that these wheels answer their purpose equally well without any central clay, while, at the same time, they burn a little longer when made in this manner. Whichever plan is adopted, the case is to be completed to the upper extremity, when the ends of the folds are to be turned down with some paste or glue, and driven down solid by means of the rammer.

The case is then ready for boring. To do this accurately, four lines must be drawn upon it, parallel to the axis, at equal distances, so as to divide the circle into four quadrants. By means of a bit of string to suspend it, the centre of equilibrium must then be found, and a mark made for the hole which is to be bored through it for the purpose of carrying the spindle. This hole need not exceed a quarter of the interior diameter; and being done, the edges of the paper are to be rubbed down smooth with grease, and a bit of tallow introduced into the hole, to remain there till the firework is wanted for use. The spindle must be well fitted to this hole, yet not too tightly, and polished; and it must also be provided with a nail head so smoothly turned inside, as not to check the motion of the wheel should it come into contact with it during its revolutions. When it is to be put on the spindle, a small hemispherical button of wood should also be forced on afterwards, to retain the wheel in its place, and prevent it from coming in contact with the support, of whatever nature, to which the spindle is to be fixed. These precautions are necessary, at least for the larger wheels of this class; although, in the smaller, they may be dispensed with; and, we need scarcely add, that all these rubbing parts should be well greased.

It is next necessary to bore the case for firing. This is done, as in the tourbillon, at the extremities of the case, and on opposite sides, and on those two lines which are at right angles to the two through which the axis passes. Thus, when the fire issues from these, the case revolves like a wheel. These holes must be equal in diameter to half a diameter of the composition; and the artist ought here to be reminded, that a set of gimblets, accurately measured from the eighth of an inch upwards, and numbered, must form a part of his establishment of tools.

It only remains to prime the wheel, which is done by carrying a single leader from one orifice to the other, and securing it with pasted paper at each. To the middle, an additional leader is attached in the same manner, which is reserved of an indefinite length, to be afterwards adapted to any place that may be required.

It is possible to prolong the action of these wheels by burning only one hole at a time, and causing the common leader to commence near the axis on one side, and be inserted into the second orifice. In this case the first priming leader is inserted into one orifice. A wheel so constructed burns and revolves very regularly at first, but is apt to become irregular as the equilibrium is destroyed. To prevent this, the communicating leader may be inserted half way between the axis and the first orifice; and thus the burning of the wheel is prolonged for one-half more the time that it would be if lighted at both ends together.

Such wheels may also be varied, so as to give two circles of fire instead of one; and this has a good effect, particularly if they are of large size. Even three circles may be introduced; but in this case it is necessary that the firework should be of extraordinary length, as it would otherwise burn out too quickly. In boring for the former purpose, one of the holes should be made towards the axis, and the other at the extremity, still however on opposite sides; and if three circles are wanted, it is easy to understand that two more opposed holes are to be made at a convenient intermediate distance. The arrangement of the leaders for this purpose is easily comprehended; and the operator may also understand how the effect of such a wheel will be improved, by forming the external circle of brilliant fire, and the internal one of a white or blue light.

This kind of firework, from its great simplicity, admits of being easily compounded, so as to produce very pleasing effects. To describe one mode, will suggest to the artist many other ways of producing variety from this expedient. Two or more cases differing in length may be fixed on an axis; each being secured in its place by an intermediate button, so that they may not interfere in their revolutions. If two, for example, are used, the one should be made to revolve in a direction the reverse of the other, which is easily managed by a proper position of the vent holes. Thus also many concentric circles of fire can be produced, either in the same or opposite directions, by placing many cases of different lengths on the same axis.

But in doing this, the larger cases should have quicker compositions than the inner ones, so that they may not last much longer. Or, what is still better, each wheel leader should be separate, and all of them provided with bits of slow-match of different lengths.

Thus the outer wheel may be caused to burn first, when, after a few revolutions, the second will take fire, and so on in succession till all the circles are inflamed. It is plain that all these things are very easy to execute, but that they require attention to be well done.

The single case wheel may also be compounded, by placing and fixing two on a common wooden centre, at right angles to each other, as in the table rocket; and they admit of the same variations already mentioned.

Of Spiral or Fire Wheels.

Of spiral or fire wheels.

Of all the fireworks that have been invented, this is the most beautiful in proportion to its expence, while it is scarcely possible that it should fail, if made even with the most common attention. Being on a very small scale, it may be fired in the hand and in a room. It does not indeed admit of being made large, as, if the stream of fire is too great, it is apt to burn the cases irregularly where the turns come into contact, and thus destroy the effect.

The lengths of the paper for forming the tubes of these wheels should not exceed a foot or fifteen inches, as they become difficult to fire, and it is better, therefore, to join two or more together, when it is desired that the wheel should burn a long time. The paper must be thin, and must not exceed two or three folds, as it is necessary that the case should burn through every now and then to give vent to the fire. These tubes are pasted up round a wire, and, before filling, are pinched close at one end. They must be filled by means of a funnel, and loosely, else they will crack in the bending; but the first trial will soon show the operator how much composition they will bear. The composition for them will be found in the table, and it need not be varied, as, owing to the occasional burning of the case, and the more or less difficulty which the fire finds in issuing, they naturally produce sufficient variety. It must be made very dry before using, as it would not otherwise fall freely down the tube.

When the tube is filled and secured by pinching at the end, it is to be passed round a wooden turned button, provided with a groove to receive it, and with a hole in the middle to receive the pin on which it is to revolve. By means of a little glue, the first turn is fastened to the cylinder or button, and the remaining turns may be secured to each other with a little paste. A bit of twine must be used, to prevent them from unfolding in the making, which can be taken off when they are dry. As one tube is expended, another may be inserted into it, and fastened by a slip of paper and paste; and thus the spiral may be prolonged to an indefinite length. These wheels may therefore be made very durable, so as to last as long as any particular firework with which they may be used. When the requisite size is obtained, the whole should be pressed flat, and secured by some transverse slips of paper.

These wheels may also be made without pasting the turns together; securing them only at particular points with a bit of glue, or sealing-wax. Thus, in burning, the spiral unfolds after each fastening of this nature, so as to increase the diameter of the circle of fire.

In firing such wheels, two may be applied on one axis, so as to revolve in opposite directions, which produces a very pleasing effect; but in this case the pin must be somewhat thicker, and must also be provided with an intermediate button, so as to keep them separate. They may also be variously combined; but as these combinations are applicable to all wheels alike, we shall reserve any description of these till we come to treat of combinations of wheels.

Of Compound Wheels.

These may be made of any number of cases in the manner already described, disposed round the circumference of a circle. Thus they may reach from two up to twelve, as there is no rule but the particular view of the artist.

If two only are required, they may be fastened on the opposite sides of a single arm provided with a proper centre and axis, and the leader must then be crossed from the end of one to the commencement of the other. Four may be used in the same manner; and in this case the circle of fire may be improved, with the same duration, by causing the two on opposite sides to burn together. If six, or twelve, or any equal number of cases, enter into the wheel, the artist has it equally in his power to improve the circle, by managing the leaders so as always to burn two on opposite sides at the same time. Nothing more need be added respecting the mode of making these, as that was already explained in the general directions for making wheels at the head of this division of the subject.

In firing these wheels, it is usual to place them vertically, as the effect is then best. But they may also be placed in a horizontal position; a practice which is chiefly adopted when they are attached to some other firework to which they are intended to communicate motion. We shall presently show how they may be varied by compounding them.

Of Horizontal Wheels.

This is a wheel, which, although placed in a horizontal position, produces a very different effect from the preceding, on account of the peculiarity of its construction. But in making it, it must be remembered, that as the force of the cases is very much diminished on account of the obliquity of their position, all the composition must be strong.

The wheel to carry these cases must be circular, and of considerable size, to give a freer motion; and the cases for it should also not be less than an inch in diameter. As many may be disposed on it as it will hold, as it is indifferent whether they are an odd or an even number.

To construct this wheel, a case is first to be attached to the wheel by its middle, at an angle of 45°, and to insure regularity, it is better that such a number of grooves as is necessary should be cut in the felly, at the proper angle. This case being thus applied, a second must be fastened on the next groove, with its mouth in the contrary direction, so as to be opposite, and close to the extremity of the first. Thus all the cases are to be applied in succession; so that when the wheel is completed it presents a zig-zag line of rockets surrounding the felly; each rocket being at right angles to the next, and all the mouths and extremities following each other alternately. The joints must then be primed and attached in the usual manner.

It is evident that the action of this wheel, when burnt, will be to produce alternately an oblique stream of fire ascending at an angle of forty-five degrees, and one descending in the same manner; while it will, at the same time, revolve round its axis. But on account of the resolution of forces, its circular velocity is only the half of what it is in any wheel of which the cases are parallel to the plane. Hence the effect is rather dull, and requires to be varied by other additions. But that effect may be improved by causing two opposed cases, one above and one below, to act at the same time, or else by making two act above, alternately with two below. The means of effecting this by a proper disposition of the leaders is too obvious to require description.

The horizontal wheel may also be constructed in another manner, and that, such as to discharge its fire at an angle either upwards or downwards. For either of these purposes the rockets are all to be laid obliquely as to the wheel, as in the former case; but in a parallel consecutive manner. Thus all the vents will look either upwards or downwards, as the artist may choose, and each head and tail are then to be alternately connected by means of an attached leader of the requisite length. It is evident that the effect of these will be a succession of streams of fire in a direction oblique to the revolution of the wheel, but always either upwards or downwards. These wheels may also be made both very forcible and far more durable than a common wheel in one plane. To give them force it is only necessary to make the angle which they form with the plane of the wheel very small, such as 10 or 15 degrees instead of 45, by which means the recoil of the rocket is caused to coincide more nearly with the plane of revolution.

Thus also they may be made of almost any degree of durability, because the cases may, in this way, lie close to each other, so as to form a solid ring round the wheel. As the weight in this case, however, becomes considerable, it will not be amiss to give these wheels an impulse at the commencement. Or, as there is abundance of materials, they may be lighted on both sides at once.

The same plan is applicable to vertical wheels, and with the same effect of producing a far longer duration than in the common constructions already described. At the same time the effect is somewhat varied from the peculiar direction of the issuing stream of fire.

All these horizontal wheels, when fixed, are commonly provided with a central white light, or with a gerbe, or with a succession of these. This is a peculiar convenience in the horizontal wheel; as the pressure being downwards on the shoulder of the axis, which must be properly adapted for this purpose, there is no danger of disturbing the equilibrium. It may also carry a Roman candle in the centre, or a number of these or of other fires upon the spokes, and that either upwards or downwards. Thus also these may be fixed, in any order of succession as to the fire of the wheel which the artist pleases; merely by selecting some particular case for the leaders to each of them. Thus this wheel becomes a complicated firework. But as it is not necessary to treat of it again under that head, particularly considering the endless variety of which it admits, we shall barely suggest here, that it may be varied with good effect even in ten different ways or more, because there is no limit to the number of cases of different kinds, which the spokes will carry, if the centres are made very fine and free, nor to the number of leaders that may be used to fire them in different ways. To put one instance of many, after it has revolved simply for a time, it may light a circle of white lights looking downwards. These may be followed by a few sparkling fires upwards, to be succeeded by Roman candles, then again by cases of serpents, and, lastly, by a central gerbe, ending by a bounce, or by a general explosion of serpents or stars. To say more on this subject would be merely to describe what the ingenuity of the operator will easily suggest.

Pyrotechny.

Of Compound Spiral Wheels.

Of compound spiral wheels.

These are formed on the same principle as the preceding, namely, that of oblique forces. The framework for this wheel consists of a long nave, capable of carrying two sets of spokes at six inches or a foot distance, as the artist may desire. Thus there is a double wheel of fire revolving on one axis. The cases are to be fixed on these in the oblique manner already described, but this wheel admits of two principal variations. All the cases may be consecutive and parallel on both wheels, with the fire directed upwards or downwards, if the artist prefers it; or else they may be reversed, so that one set of fires shall act obliquely upwards, and the other obliquely downwards. Care must be taken, however, that all the recoils may have the same tendency; and it is plain that the force of such a double wheel will, with an inclination of 45 degrees for the rockets, be equal to that of a single horizontal one in one plane.

Besides this, however, the effect may be varied by causing the fires of the upper circle to tend downwards, and those of the lower one upwards. Thus they may be caused to cross each other, so as to produce a much better effect than in either of the preceding modes. A variation may be produced even upon this plan, by either actually crossing the rockets themselves, so as to separate their streams of fire, or by bringing the two mouths together from the lower and the higher wheel, so that two oblique and diverging streams shall appear to issue from one point. A horizontal wheel may be added to these to increase the revolving force and vary the effect; and, as in the former kinds, they may carry additional fixed fires upon the spokes.

This spiral or compound wheel may further be doubled; or the same axis may carry two pairs, each of which pairs being approximated in the manner already described, a very complicated and brilliant intersection of streams of fire is the consequence. There is no danger in these contrivances of wanting force, provided the machinery be well made, as the friction does not increase in so great a ratio as the powers of recoil.

Of Diverging Vertical Wheels.

Of diverging vertical wheels.

The construction and nature of this contrivance may be easily apprehended from the description of the former. The wheel requires, however, to be differently made, as far as the felly is concerned. Provision is to be made for attaching the cases to it, not in the outer margin, but in the flat side of the felly, and on both the opposite sides. For this purpose grooves must be cut in it at all the points where the cases are to be attached, which may be numerous in proportion to the relative diameter of the wheel and the lengths of the cases. These must be made as accurately as possible at angles with the tangent at those points, which may vary from 5 to 20 degrees, according to the degrees of divergence which it is desired that the fire should have. But the angles on one side of the felly must lie above the tangent, and on the other below it. Two cases are then to be attached together, one on each side of the felly, with their mouths parallel, and as near to each other as possible, and in the same way the wheel is to be completed all round. It must then be primed, and regulated by the leaders in such a manner that both rockets, on opposite sides of the wheel, may burn to-

Of Compound Wheels.

Of compound wheels.

These have a very pleasing effect, and may be varied in many different ways. The general principle on which all the effect depends, is that each additional wheel should be carried along by the motion of the principal one, independently of its own proper motion. Thus it describes a complicated path, like a running flourish; or similar to that which the moon makes round the sun, as we formerly mentioned. For all contrivances of this nature, the smaller wheels should be very much less than the principal one. Hence pin-wheels answer very well, except for very large works, when triangular ones may be adopted.

According to the methods in which these are arranged with respect to the principal one, will the effects vary; and, compared to the little contrivance that is required to produce them, they are very striking. Thus let a common hexagonal wheel have as many smaller ones fixed on its spokes inwardly as will be sufficient to last the same length of time, then the principal circle will be attended by one of these flourishing movements in an inner circle. If they are fixed on the spokes prolonged beyond the circumference, the same flourishing line will be outside of the principal circle. Otherwise, which is still more beautiful in the performance, the small wheels may be placed between two concentric plain wheels, when there will be two circles of fire with an intermediate flourish, which may also be much improved by adding a light in the centre. In addition to this, a second flourish may be also added outside, which is nearly as great a degree of complication as this kind of wheel will bear.

Fig. 31, 32, 33.

The same method is to be followed for all these, with the requisite variations for the leaders and other connections. We shall suppose the simplest case of one flourish within the principal circle, as the method of arranging this, will serve for the explanation of the whole. If there are six cases in the outer wheel, and the diameter of it is two feet, then the diameters of the smaller wheels will be from four to six inches. Three of these will be required; and of whatever shape they are made, each of them must be equal in the time of burning to two cases of the outer wheel. They must then be fastened in opposite spokes, so as to preserve the proper balance of the wheel, by means of spindles in the usual way. For firing, a leader must join the commencement of the principal wheel with one of the small ones; a second leader must join the beginning of the third case with the next; and a third leader is required to join the fifth case with the last. Thus one of the small wheels will burn with each two cases of the large one, and the effect will be continued during the whole time of the revolution, so that the whole will expire together.

Balloon Wheels.

Balloon Wheels.

This is one of the fireworks mentioned in the books on pyrotechny; but it is scarcely worth describing, after the remarks formerly made on the methods of varying the effects of horizontal wheels. The name is not very appropriate. It is a common horizontal wheel, with horizontal cases revolving in the usual manner. On each spoke near the end of each case is placed a pot of serpents or of stars, or of both alternately. These communicate by means of a leader with the end of each case, so that whenever a new one is lighted, a discharge of serpents or stars takes place. The same expedient may be applied to a vertical wheel, but in this, stars are not admissible, on account of their danger, as they would be thrown forwards among the spectators. Small serpents may safely be used, as they do not fly forwards, and are therefore not likely to occasion accidents in this way, more than in the horizontal wheel.

Star Wheels.

These may be used either horizontally or vertically; but in the two kinds the stars require to be differently disposed. We shall give a direction for each. If the wheel is to be horizontal, the best method of dispersing the stars is to fix as many Roman candles in the centre of the wheel as there are cases in its circumference. This we formerly alluded to in speaking of horizontal wheels. These must be in a vertical position, so as to throw their stars upwards, and they must be calculated as nearly as possible, so that one may last as long as one of the wheel cases. To prepare this firework for firing, a leader must be conducted from the commencement of each case, to the top of each Roman candle in succession; so that a constant discharge of stars, together with a central fountain of fire, will continue as long as the wheel lasts. The Roman candles may also be disposed in such a manner as to throw the stars downwards, instead of upwards, or alternately upwards and downwards, or both ways at the same time, all of which produce fireworks of different appearances.

In using stars with vertical wheels, a different disposition of the Roman candles is required. They must be fastened on the spokes of the wheel, with their mouths looking outwards; and the leaders must be placed in the same manner, so that one Roman candle may fire with each fresh case. The stars will thus be projected sidewise, without any chance of injury to the spectators, who are always in the front on those occasions; and as they receive two motions, one from the wheel and the other from their own projectile force, they form very pleasing curves in the air, adding much to the beauty of the effect, while they also seem as if they were projected from the mouths of the wheel itself.

If it is wished that a vertical wheel should throw up stars in a vertical direction, a separate firework is required for this purpose. This must consist of as many Roman candles as will last out the time of the wheel, and they must be fixed behind the wheel on the same part which carries the axle. But if it is wished that stars alone should be seen, without any vertical fire, so that the wheel itself may appear to throw up the stars, they must only have a very slow composition, which gives little fire, such as that used for portfires, which will be found in its proper place. The orifices may be also concealed behind a board, so that nothing but the stars will be seen. As many of them must be connected alternately by the head and tail as will last out the time of the wheel, and the same leader will serve to fire both. It is proper that all wheels and fireworks of this kind should end with a report, or with a general explosion of stars.

Of the Alternating Wheels.

The effect of this is entertaining, nor is the construction difficult. In burning, a large and a small wheel are seen alternately, and in concentric order. This irework is required particularly for illuminating a species of transparent star, which will be described hereafter; and to aid the understanding in its construction, a plate of it is given.

It may be made of any form or number of cases, but t is necessary that both the wheels should be attached o one frame, and work on a common centre, as the eaders could not otherwise be made to communicate. Both the wheels should also be of the same duration. This may be managed either by making the composi-ion of the inner one twice as slow as that of the outer, or else by doubling the same cases in the inner. Thus, f the outer wheel consists of six cases in hexagon order, the inner may have the same number disposed in a double triangle. In uniting the leaders, care must be taken that the tendencies of both wheels are preserved in the same direction; and that we may render the disposition of these more intelligible, we have chosen a simple form on which to represent it.

Of Combinations of Fixed Cases.

The forms into which these may be considered are almost endless, and there is indeed scarcely any limit to them but the expence. We shall only here describe a few of the most practicable, as from these the artist may easily extend them to any number he thinks proper by variously combining them. We have also given figures of these, which will save a good many words in the description.

The general rules are alike applicable to all. For some, such as all the fires which contain iron, the cases must be choked, as they must be considered as gerbes; and these compositions must be varied with iron-fire, and with common charcoal fire. They must also be provided of two or three different lengths, and also of different sizes, for the sake of varying the effects. Besides these sparkling cases, there must be ready a number of cases, of different sizes also, of white and blue lights, together with crackers, stars, serpents, and Roman candles. With these at hand, the artist will be able, in a very short time, to make up all the different forms that he may fancy, instead of being checked in his operations for want of materials. We need scarcely say that various shaped frames will also be required; but as all these are immoveable, there is no difficulty in their construction.

These combinations are generally made out of large cases, seldom being formed out of such as are less than an inch in diameter; as, when upon a small scale, their effects are not sufficiently distinct. Such cases are also often required to be of an unusual length; but as it is not convenient to drive them longer than eighteen inches, if more is wanted, it is better to join two together in the same manner as the cases of pin wheels are united. But as such very long cases will not burn out well when the orifice becomes too distant from the fire, the paper case must be made so thin that it will burn down; or, what is better, a part of it may be unrolled after driving. It is chiefly where a white light is wanted to burn for a great length of time, that this precaution is required.

It seldom or never happens that these combinations are used alone. They are sometimes the termination of some other simpler display, or else they form part of some general system of mutations. In all cases, they must be provided with a general leader for the purpose of setting them on fire, independently of the particular ones which, by firing all the cases in their proper order, are to produce the intended figure in fire. If they are to follow after wheels, as these cannot communicate light to any thing, that leader must be in the power of the operator; otherwise it is fastened to the end of the firework, of whatever nature, which it is intended to follow. But the greatest care must be taken in the adaptation and protection of these, that they may not fail to communicate, and that at the proper time, that they may not take fire accidentally from the sparks which may be flying about, and that, when they do fire, they may not burst in such a manner as to derange themselves, or any thing about them.

Geometrical Figures.

Geometrical figures.

Plate CCCCLXXIII. Fig. 1–5.

The chief of these are crosses, triangles, squares, hexagons, and octagons; beyond which the figures approach too near the circle to produce a distinct effect.

In the cross, the four cases are disposed with their mouths outwards; and the effect of this firework is much improved, by placing a bright light or a small wheel in the centre. Or else four lights may be attached upon the cases, so that the same case may appear to be throwing out both the sparks and the light. In many fireworks, this is a deception which may be used with very good effect.

The triangle, square, &c. all act on the same principle, so that the same rules will serve for the whole. Wherever there is an angle, two cases meet at that point, so that their fires cross outwardly, these producing a variety of regular and pleasing figures. Thus in the square, for example, they form four external right angles; in the hexagon, six triangles.

All these admit of various additions, from the introduction of wheels or of white lights, or of smaller cases of sparkling fire; some examples of which will be seen in our figures. We shall content ourselves with here describing one or two varieties, as specimens from which the artist may easily learn to contrive many more.

A hexagon may have a blue light fixed on each angle where the cases meet, and another in the centre. Or instead of the light in the centre, it may have a small wheel. Wheels for this purpose are conveniently made of simpler cases when the figure is single, as they may easily be measured for the same duration as the figure in which they are placed. Thus as the whole hexagon can only burn as long as one of its cases, a wheel that is formed of two cases crossing each other, as in the table rocket, each of which burns at both ends, and the two in succession, will last exactly as long as the geometrical figure in which it lies.

Instead of this arrangement, six smaller cases may be placed within the centre of the hexagon, with their fires directed outwards in form of a star. For this purpose the mouths must be placed together, that all the fires may appear to proceed from the same point, or a light may be placed on this point besides. Or else the cases may be fixed to the circumference of the frame that carries the hexagon, so that their fires may be directed inwards. The same principles may be applied to all the other figures, and with the effect of producing different varieties of form; as may easily be imagined without the necessity of any further description.

The Ostrich Feather.

The ostrich feather.

This is a very pleasing form of sparkling fires, and is generally used for terminating complicated fireworks

PLATE CCCCLXXIII. Fig. 6. that have a pyramidal form. It is also used to imitate the Prince of Wales's crest. When this latter effect is to be produced, it must be attached behind a transparency properly painted to imitate the coronet and the inscription, and this must be strongly illuminated with blue lights placed behind it. Care must be taken that the mouths of the cases may be so placed, as that the feathers may spring from the proper point, and at a right distance from each other. They must also be inclined forward from the perpendicular, that the fires may turn over at the top of their ascent towards the spectators. Three cases produce the three feathers, and these must be of brilliant fire, and of considerable size. But the feather may be made richer and fuller, by placing in it three or four of a smaller size. If also it is desired that it should be very durable, it may be made to last for double the time, or even much more, by placing a succession of similar cases behind each other, and so managing the leaders as to light one set when the other expires. The same rule may also be applied to all other fixed figures of whatever nature; which is often of great use, as they may be required to keep time with other fireworks of longer duration.

The ostrich feather may also be used without the coronet; in which case it may be provided with a small wheel, or a bright light at the point where the feathers spring.

The Tree.

The tree. This is the name generally applied to all those combinations of fireworks which throw out fires from each side of a perpendicular; and there are different ways of disposing the cases for this purpose. The simplest method is to dispose the cases upon a perpendicular post, in a parallel manner on both sides, so that when placed they may resemble the feathers upon an arrow. The angle with the perpendicular may be about 30 degrees, so that the fires will diverge at 60, but the artist may vary that angle according to his pleasure. The perpendicular should also be terminated by as many cases as will render the whole figure uniform at the top when burning. Fig. 7.

This disposition may be agreeably varied in two ways or more. Thus, instead of fastening the cases on a straight post in a parallel manner, and having all the mouths at the same distances crosswise from the top to the bottom, they may be placed upon two posts inclined at a small angle, so as to make an acute triangle. Fig. 9. Or else this position may be reversed, and the broadest side of the triangle may be upwards, so that the tree will appear to spread at the top. In this latter way also, the cases below may be more widely apart than those above; and as the interval at the top must also be filled with cases, the tree will appear fuller or more bushy above than below.

In the next place, the cases, instead of being placed at equal distances upon the perpendicular, may be arranged in pairs, so that each alternate interval may be twice as wide as the next. Fig. 13. Or else the direction of the fireworks may be entirely reversed, so as to throw their fires downwards instead of upwards; or they may be placed horizontally. Fig. 10. They may still further be varied, by causing a certain number to play upwards, and the remainder downwards, the middle one on each side being horizontal; and this contrivance may also be further varied in two ways, that is, by causing the bottom division to play downwards, and the top one upwards, or the reverse. Fig. 12. Although in description these do not seem to differ much, the effects are very dissimilar. It is also a great advantage that so many varieties of form, where variety is so much wanted, can be attained with so little trouble.

The last method of disposing this kind of fire which we shall notice, is where the fires of two cases cross, or start from one point. The cases for this purpose are arranged like the teeth of a saw on each side of the perpendicular, and so that every two neighbouring mouths are together, the effect of which is easily understood.

All these varieties of the tree may be modified in various ways, by the addition of blue lights, or of small wheels, or of pointed stars; but it is scarcely necessary, after the preceding remarks, to give directions about matters so obvious.

Pointed Stars.

As this is one of the combinations of fixed cases, which is perpetually wanted in compound fireworks, it must now be described. It is necessary, to insure regularity in these, that they should be made in proper patterns, or stands of wood or metal, all regularly cut to one size and disposition of angles. The reason for this care is, that it is generally necessary that a great number should burn together, and when they are not equal the effect is unpleasant. The cases for them may be from an inch and a half to two inches in length, and from a quarter of an inch to three-eighths in diameter, and they must all be driven with the greatest care, so as to burn exactly the same length of time. The composition may be white or blue, and will be found in the table. The wooden frame in which they are to be fastened, must have grooves for their reception, and may be furnished with five or six of these, exactly geometrical. The five-pointed star is most commonly used; but that with six points is rather more ornamental. There must be a hole in the frame, to admit of the star being nailed to any place where it may be required; and the artist should always be provided with a great number of them ready made, as they are always wanted, and will keep for ever. The common leader of the whole is fixed round them ready for use, having one loose end by which it may be fastened to any general leader; and in fixing the cases upon the frame, care must be taken that their mouths are sufficiently near to each other to produce the effect of a star in burning.

Where small stars only are required, they may be made with single cases. The case for this purpose must be from an inch upwards in diameter, and of similar lengths; and upon it must be marked by a compass at proper distances the requisite number of points, whether five or six. As many holes must then be bored into the composition, and a leader so disposed as to light the whole at once. These cases should be very thick, to prevent the holes from enlarging during the burning, which would spoil the effect, and if the paper be well soaked in alum water, and the paste made with alum, it will stand any fire without enlarging the orifices.

Of Suns and Stars.

These may be formed in a great variety of ways, so that we must be content with describing and representing a few only of the most remarkable. The frame work necessary for these must consist of wheels, having concentric hoops upon the spokes, for the greater facility of attaching the cases.

A simple star is easily produced by six or more cases adiating from a centre. If the mouths of these are laced outwards, the centre must be filled by means f a wheel, or some other object; but if it is required hat the star should be complete without addition, the mouths of the cases must be inwards, taking care at the ame time that all the fires may spring clear of each ther. A better star may be formed, by placing six lue lights in short cases alternately, with as many rilliant ones in long cases, so that they may form two tars together, of different colours and of different dimeters. This may be further varied by the introducion of a central light.

Stars more complicated may be made in many different ways. Thus twelve large cases, or more, may e placed on the circle, so as to look outwards; while he same number, or six, of a much smaller size, may e placed on the same circle, either alternately, or at he same points, with their mouths fixed to the circumference, and looking inwards. Thus on firing a doule star will be formed, one in the centre of the other. Or else the mouths of the central or inner star may also e collected in the centre, so as to throw their fires outwards in the intervals of the larger star.

When this arrangement becomes more extensive, it forms what is called a sun. To construct this, twelve or twenty, or more cases, are fixed like rays outwards, so as to occupy the circumference of a large wheel. On an inner circle, and in the intervals of the first, are fixed the same number of cases of a smaller size; and if the artist thinks proper, a third circle may be arranged in the same manner, either of the same fires or of some other kind. If all these are fired at once, an immense blaze of circular fire is produced. But as in all such fireworks, it is better to begin gently and to end with more brilliancy, the leaders may be so managed that the three circles shall light only in succession; the cases being so timed as to duration, that they may at any rate end together, however they may begin.

Such is a simple brilliant sun; but it admits of being varied in many ways, by the introduction of white and blue lights. Supposing a sun of large diameter, constructed of one circle of brilliant fire, concentric circles of small lights, to the amount of two or three, may be placed upon the inner hoops of the frame, and the centre may at the same time be occupied by a large light, or by a pointed star, or by a small wheel.

Otherwise the small lights may be disposed upon the spokes of the frame, in radiating lines, the centre being occupied in a similar manner.

A very beautiful figure of this kind is made in a different way. For this purpose, twelve or more spokes of the frame must be prolonged to the distance of two or three, or more feet from the centre, in which a single light or a wheel, or a pointed star, may also be placed. These are to be covered at three or four inches apart, with small blue lights, so as to form long radii diverging from the centre. Intermediately between these are to be placed cases of brilliant fire, with their mouths so situated as to form a circle considerably within the extremity of the rays of light, so that on firing, a ray of spots, and one of brilliant fire, may be placed alternately. It is easy to see that this kind of complicated sun may be varied in many other ways, but it is unnecessary to describe any more of them, as any artist may vary them without end, since there is no limit to this kind of fireworks but the expence.

Suns of this kind are sometimes used with transparencies, representing the face of the sun. But the effect of these is vulgar and bad, as the paintings must necessarily be in a barbarous taste; so that they are far better avoided.

Cascades.

Cascades.

These are commonly used to terminate other fireworks in complicated arrangements, as, from the immense quantity of fire which they display, it is not easy to introduce any thing after them with effect. The frame for this purpose may be made of a pyramidal form, with cross bars for the attachment of the fireworks, and with as many tiers of these as the artist may choose. They are then to be disposed in successive rows, and in alternating order, with their mouths downwards. Fig. 19.

But the effect of a cascade is much better represented by a somewhat more complicated construction. The frame for this purpose must be so formed, that every tier for the attachment of the cases may form a curve outwards, so that the whole becomes part of a cone. In this case the rockets are also fastened upon the tiers, in such a manner as to be parallel to the sides of the cone, so as even to be further projected outwards towards the spectators. Thus the whole mass of fire assumes a more round and solid form; and as the sparks descend they also form curves, so as to produce a much richer effect. It is also not unusual to terminate such a cascade by the addition of a gerbe, or an ostrich feather at the top. If any lights are introduced into it, its character as a cascade is destroyed, as it is indeed in a great measure by the addition last named. Fig. 20.

Fountains.

Fountains.

The common gerbe makes a fountain on the small scale, but when a greater display is wanted it must be produced by compounding many cases together. For this purpose a frame of wood must be provided, in the form of a hollow cone, with hoops for the attachment of the cases. The angle of this cone may vary from 60 degrees upwards, according as it is wished that the fire should spread more or less. The cases may then be disposed either inside or outside of it with their mouths at equal distances, so as to throw, when fired, an equal shower of fire all round. A finish should be given to this fountain in the centre, by means of a large blue or white light. Fig. 21.

If such a cone were caused to fire downwards, instead of upwards, it would form a cascade somewhat different from that first described; or else two cones may be placed together in opposite directions. Such a fire as this requires, however, to be elevated very high, that its full effect may be displayed; so that it is only adapted to the centres of great displays, where it may succeed, in a piece of architecture, to other fires of a more moderate effect.

The Yew Tree.

The yew tree.

We use this name, and describe this firework, because it is mentioned in all the books on this subject. It is extremely simple to construct; nor is there any thing very particular in its effect. It consists merely of a number of cases or gerbes, arranged in successive stages; and in an alternate order, in the form of a pyramid, and the effect of it is easily understood. It admits of being varied with advantage, by placing rows of single lights along the supports of the cases, or by adding a pointed star to the bottom of each case. Fig. 22.

The Palm and the Cypress Tree.

The palm and the cypress tree.

This is a very pleasing way of arranging cases of brilliant fire, particularly on a large scale. For this purpose, the frame must be regularly constructed with a support for each case, as the artist must not trust to his eye for arranging them, when the beauty of the effect depends upon the accuracy of the angles at which they are placed. Nineteen cases will form a regular figure of this kind, in the following manner: Let the perpendicular part of the frame work be divided into nine equal parts, at any distances which the artist may think proper, and which may be conveniently a foot, if the cases are to be a foot long. At the lowest point is to be fixed a horizontal bar, capable of supporting a case on each side. At the next point above, the bar must form an angle of ten degrees with the horizon, the following one twenty, the next thirty, and so on to the top; and the same is to be done on the opposite side of the perpendicular. When the cases are attached to these, there are of course nine on each side, exactly corresponding in their angles, together with one at the top; and when it is fired, all these form curves successively radiating towards the ground. The artist may, if he pleases, crowd the cases more towards the top than the bottom; but this must be done in a regularly diminishing manner, by a proper arrangement of the frame work, which is too easily understood to require description. Fig. 23.

The effect of this firework may be varied by placing the cases on each side of two posts, inclined in such a manner that they may diverge at the bottom, taking care that the same angles with the perpendicular be nevertheless preserved. In both ways lights, either single or in the form of stars, may be introduced along the perpendicular, or at the bottom.

This tree may also be doubled, in which case, like the double cascade, it must be exhibited at a considerable elevation. For this purpose, the same operations are repeated below the horizontal cases as above, as may easily be understood. Further, it is varied by making the upper cases at wide angles upwards, and the lower in small ones successively diminishing and looking downwards, when it is properly the palm tree. Fig. 24.

Checkered Fires.

Checkered fires.

These have also a very brilliant effect, and that in proportion to their numbers and complication.

To produce a simple checkered fire, two perpendicular posts must be placed at a proper distance, such as three or four feet, for one foot cases, and on these are to be placed as many cases as the artist may choose, in angles of from 40 to 60 degrees, with their mouth opened, and upwards. Thus, when lighted, the fires intersect each other so as to produce a network, the nature of which may be varied by altering the angles of the cases, or by placing them at greater or less distances from each other. This is also called a double tree.

A reticulating fire may also be produced in a different manner, by placing a number of cases in a radiating form upwards, on a horizontal bar, and opposing them to the same number radiating downwards from a bar above.

Such fires as this admit of being multiplied with great effect. Thus, instead of two perpendicular or two horizontal bars, there may be four or more, and thus an immense mass of net work may be produced.

But, in these attempts, care must be taken that all the bars are at a sufficient distance, to prevent the several fires from confusing each other. This is a point which the artist must regulate according to his cases; it being easy, by burning one, to ascertain precisely how far it throws its stream of fire.

We need not here add any thing respecting the manner in which all these fireworks may be varied by the addition of lights or stars, as it would be merely to repeat what has been said before on that subject. Neither need we do more than barely suggest, that by a proper disposition of cases, any of these may be caused to throw up stars or serpents at any period that the artist may choose.

But we may as well suggest that a good way of terminating all these fireworks is by discharges of sky-rockets, which, for this purpose, may easily be secured out of danger behind a proper board, and so as to communicate by means of leaders with the last portion of the fixed work. Sky rockets may also appear to be thrown up by these at any time. For that purpose, it is best to have a case of some slow fire, like a port-fire, which gives little light, and the burning of which is accurately known. Proper holes being then made in it, at regulated distances, with a leader to each rocket, they can be discharged in succession at any interval which the operator pleases, and without the least difficulty. It is only necessary to take care that, while the leaders are so well secured to the mouths of the rockets as to prevent the entrance of any accidental fire, these may at the same time be so weak as to be easily detached by the blast of the rocket, so as not to impede its ascent.

Of Complicated Fireworks.

To attempt to describe even a very small part of what may be effected by complicating different kinds of fireworks, would in itself require a volume, both of descriptions and plates; as, without the latter, no words could render them intelligible. We shall therefore limit ourselves to a few, which, either from their being in common use, or from their beauty, or from their suggesting hints for the construction of others, may appear most deserving of description. We must also confine ourselves to the simpler complications; because, as these may again be combined without end, there would be no limits to such a treatise. It is an art in which no one will succeed well on a great scale who has not some invention and taste of his own; and therefore minute and numerous directions would be nearly as superfluous to one class of readers as they would be useless to another.

The general rules for all complications of this nature are the following: An agreeable general outline, in the form of the fire, should always be studied; as a great deal more than is supposed by vulgar artists depends on picturesque beauty in these cases. All pyramidal or angular shapes are therefore preferable to parallel or square ones, which generally look heavy. Circles and ellipses exceed all other forms in beauty; but the latter has been very much neglected by pyrotechnists, who are too apt to proceed according to old routines. No firework of this kind should therefore be constructed without previously making a drawing of it; as also of its effects, which, for greater security, should be done in colours, so as to resemble the intended fire as nearly as possible in its colours, as well as in its form.

The next thing to be recollected is, that there should be no dullness in the execution, as the essence of all fireworks depends upon their liveliness. If any thing dull appears prudent, which it may sometimes be, for the purpose of being followed by something brilliant, and thus exciting surprise, it should be of short duration, that the spectators may not attribute to a failure what is the result of a design. It is a necessary rule also, that a firework of this kind should commence in a tranquil manner, that it should go on increasing in splendour and force, and that it should terminate as suddenly as possible at the height of its strength. It is always very unpleasant to see them expire gradually. Hence it is useful to be provided at the termination with reports, or stars, or explosions of serpents, that the attention may be taken off from the principal work, which, with all the care that the artist can bestow, will not always burn out alike. But all draggling of solitary cases at the end, ought as far as possible to be avoided, and for this purpose the artist must attend to the directions formerly given about *time*.

Lastly, the greatest care must be taken with respect to the management and disposition of the leaders, the freedom of all parts where motion is required, and the general steadiness and accuracy of all the former works.

Of fixed Illuminations.

These are all performed by means of small speckies or lights and stars, and their forms are endless. We have given figures of a few of the simplest and most beautiful, which will render any description almost unnecessary.

Rays of spots, or concentric circles, have always a very beautiful effect; but they are much improved by combination with some other fires, or by being united to some other forms in an architectural arrangement.

The imitation of a branched candlestick forms a firework that may be burnt by itself, as its shape is very ornamental. The stem or foot should be a double row of lights, with one or two additional ones transversely where wanted, to mark the places of the mouldings. Each branch requires a single row only, and they should terminate by a small gerbe on each, taking care that it is not too powerful. Or else in place of the gerbe, a large light may be used of a different colour. Thus the chandelier may be drawn in blue lights, and a white one may be placed for the lamp upon each branch. This firework may sometimes be particularly in request, from its allusion to free-masonry.

An angular star, resembling those worn in orders of knighthood, is also easily made, merely by placing lights on a frame, constructed from an appropriate drawing; and such stars may also be useful on particular occasions, from their allusions to dignities of various kinds. Their forms may easily be varied, so as to represent the stars of any particular order.

A very elegant firework may be made in imitation of a palm-tree, by means of illumination lights combined with small cases of brilliant fire. From the top of the trunk, which is lighted by a double row of cases, the branches must spread out on each side in curves, as represented in the plate; and on each of these must be placed a single row of lights, each branch terminating by a single case of brilliant sparks. A small wheel may also be placed at the point where the branches spring; and it will be better if these, and the cases at the end, are not lighted till the illumination has burnt for some time.

Very beautiful combinations may be made by means of single lights and pointed stars. A few of these must here suffice. A single star may be placed in the middle, and surrounded by one or more circles of spots; and such a firework as this may be executed on a very small scale. Or else numerous pointed stars may be disposed in a circle on the outside of rays of spots, or on the outside of circles; or, lastly, a circle of stars may surround a wheel.

Architectural forms are also made in this manner. These are applicable on a small scale; but on the large they are absolutely necessary, as it is only in this manner that the design of a large building can effectually be given. A few examples will be sufficient to show how much more complicated specimens may be managed. But it is important that correct drawings should first be made and transferred to the frames, and that fastenings should be previously placed on every point where a light is to be fixed. In cases like this, correctness of general design is most important; while it is no less so, that all the lights should be correctly placed as to their positions and relative distances. The least error in these respects is very offensive to the eye.

If an arch is to be represented, which is a very common case in exhibitions, the whole line should be strongly defined by numerous lights; and, generally, this should be done by a double row. If it is a Gothic arch, three or four rows may be required, for the purpose of representing the numerous parallel lines of this class of architecture. Wherever basements, or horizontal mouldings, or entablatures, are required, these must be defined by horizontal rows. In Doric architecture it is also easy to represent the triglyphs in the same manner; but such things as this are never wanted except on a very large scale. Fig. 10.

In a series of arches, or an arcade, the spandrils may also be marked by a pointed star; and the same ornament may generally be freely used throughout pieces of architecture, as it does not interfere with the general designs. Fig. 11.

Columns of any order are defined by lines in their margin; and capitals of a fanciful kind are easily formed for them, by means of stars and lines of lights. A sort of excuse for the Ionic volutes may be produced by two larger lights. To represent twisted columns is extremely easy, and these are very ornamental; and if the building is extensive, windows and doors may be defined in the same manner. Fig. 13. Fig. 14.

The necessary tranquillity of architecture does not admit of the introduction of sparkling fires, except in the form of mutations or additional parts. But in this way gerbes and Roman candles may be introduced on the tops of buildings, with feathers, stars, wheels, &c. Wheels may also be introduced on the faces of the building, taking care to place them in such positions, and to make them of such sizes, that they may coincide with the general architectural design, without which their effects are unpleasing instead of being ornamental. They may, for example, represent marigold windows. Where gerbes are introduced, they stand with most effect on the summits of columns, or on Gothic pinnacles; and in single pinnacles or steeples, rows of brilliant fire may also be introduced with good effect in the place of the crockets; as triple combinations on a small scale may be adopted to represent finials. But on this subject it is endless to dwell, as the artist must, after all, be guided by the draughtsman, who will dispose of his ornaments for him on proper principles, and without whose assistance it is in vain to attempt works of this nature.

Of moveable illuminations.

Of moveable Illuminations.

These also admit of great variety; but we must for the same reasons be satisfied with describing a few. In general, it is a good rule that whatever motions they are to receive should be given by means of wheels; but, as we formerly remarked in our observations on machinery, this is sometimes not possible, owing to their great weight and complication. Proper machinery must then be adopted; yet there should always be wheels attached, that the firework may at least have the credit, in the spectator's eyes, of being able to produce its own motions.

PLATE CCCCLXXIII. Figs. 29, 30.

One of the most common and pleasing of these is a spiral cone. The frame for this is attached to a horizontal wheel revolving freely on its centre, and is provided with a spiral line, to which the lights are fixed at a short distance. It may be of any dimension which the artist chooses; but a height of four feet, with an angle of about thirty degrees for the cone, forms a very convenient figure. The horizontal wheel below is driven by horizontal brilliant fires, or by oblique ones, in any of the modes formerly mentioned when treating of horizontal wheels. Sometimes the cone is terminated by a star or by a single gerbe. The figure of an inverted cone is not pleasing, nor is that of a double one; but both may be used in large displays where variety is required.

Figs. 31, 32.

A cylinder may also be constructed in a similar manner, and this may be very agreeably varied, by attaching a horizontal wheel both above and below, by which means also some additional revolving force is gained. Cylinders revolving in this manner, may form a very beautiful firework alone, if on the upper part there is fixed a fountain of fire, so as to spread over on all sides.

In all these figures, which have lights spirally disposed, and which revolve at the same time, the effect produced is that of a screw in motion, and hence they are applicable to architecture, or in other combinations, in a variety of ways. They may also be made to revolve horizontally; and for this purpose two wheels must be attached to the ends of a cylinder. Thus, however, the particular effect of the wheel is lost to the spectators, otherwise than as they will represent a stream of fire at each end directed towards them. Such a firework may however be rendered beautiful, by adding to it some fixed cases that may throw their fires upwards, so as to intersect above in the manner of a Gothic arch.

Erect cylinders may also be rendered entertaining, by causing two, placed near each other, to revolve in opposite directions; and cones may also be treated in the same manner.

Fig. 33.

Lights placed on a spiral within a circle also produce a pleasing effect, as the spiral appears to be unwinding as the circle revolves. Such a figure may be inclosed within a wheel of fire, or else the wheel may form the centre of the spiral. Two spirals placed one before the other, with their tendencies in opposite directions, and turned in contrary ways, also produce a very striking kind of firework; but they require to be accompanied by something else, as their appearance is otherwise naked. They may form appropriate centres for a piece of architecture, or they may be accompanied by cones or spiral columns.

Fig. 34.

The last method which we shall describe, is that of placing lights round a globe; and this may be used at rest or in motion, while the motion may also be either horizontal or vertical. This is a very handsome arrangement, and forms a very appropriate ornament for the heads of cones, or pyramids, or columns, or for particular parts on the outline of a piece of architecture. The lights may be disposed on the globe in meridians, or in lines parallel to the equator, or else in spirals. This latter method is chiefly applicable where they are to turn in a vertical manner. Or lastly, if the globe is of large size, the lights may be disposed all over it at equal distances, so as, if near, to represent a very solid globe of spotted fire. In this case they should not revolve.

The frame work for globes must be disposed according to the different ways in which it is intended to place the lights; and when they are to revolve, a proper axis must also be provided. They may also be caused to revolve by means of wheels, in which case they produce complicated appearances, and it is also an improvement on them for particular purposes, that they should terminate by a gerbe. If very large, they may contain one large light in the centre.

Of the Dodecahedron.

We feel it a duty to mention this firework because it is found in all the books, but chiefly for the purpose of cautioning the artist against it. It is what its name expresses, a dodecahedron, carrying a wheel upon each face. The effect of this is as confused and bad as the contrivance is in itself expensive. Many other similarly confused arrangements are to be found in all these books, which, like the compositions which we have elsewhere condemned, seem to have been put down by mere guess, without even the trouble of considering what the effect would be on burning. We shall not, however, crowd our pages with any more of this useless matter. Our only object is to caution the artist against making up any firework from these printed directions, till he has well considered what its effect will be when lighted; and for this purpose, he will be much assisted by making a detailed drawing of its fires on paper, in the manner we formerly suggested. He must in all his contrivances, whether borrowed or original, carefully consider not only the general picturesque forms and other circumstances formerly described, but how the fires are likely to interfere with each other; as, for want of such attention, he may gain nothing for his trouble but a scene of confusion. And as all cases throw their fires to a considerable distance, with the exception of *lights*, he must especially take that into consideration, and not imagine that he has obtained any particular figure merely because the cases are disposed in a pleasing manner, or in some determinate form.

There is another great object to be considered in all these contrivances, and that is economy. This dodecahedron is a very good example of the neglect of this essential quality; as in destroying eleven wheels at one time, scarcely one half of them would be visible. The best effects are often produced by the least fires, provided they be tastefully disposed, and the artist cannot do better than keep in his mind the singular economy of the Chinese in all their fireworks, as they often produce better effects than ourselves with a tenth part of the fire. To keep the fires at a sufficient distance from each other, that their figures may not interfere, is the first requisite for this object; as far greater extent, with greater beauty at the same time, is thus produced. Even in many of the fireworks which we have here introduced, in conformity to the usual practices, there are many of which the expence is very great, in consequence of the quantity of fire which they consume at once, without at the same time being so entertaining as many others which would not cost half the money. Picturesque arrangement, which costs nothing, is also as highly conducive to beauty as it is to economy; and this object is attained also by a proper contrast of fires, and by a less free use of those violent kinds, which are not only expensive, but rendered more so by their transitory nature; since they occupy but a small portion of the time which the artist is bound to fill up in some way or other.

Fireworks are still further capable of complication, by admixtures of illuminations with wheels and with fixed cases, in all the different modes in which these may be disposed: and the forms that may hence be produced are almost endless, by attending to the general directions already given respecting picturesque forms, contrast of fires, and independence of display for the respective kinds. The moveable and immoveable here also admit of being united in many ways, and the effect of these intermixtures is generally very good. We might extend this part of our subject also to an unlimited length, but shall content ourselves with placing before our readers a few of those which combine, at the same time, as far as that can be done, beauty with economy and effect. In doing this we shall present them chiefly with new forms; rejecting without hesitation the barbarous and complicated contrivances described in the books on this subject; the greater number of them being as expensive as troublesome to make, and as difficult to manage as they are confined and bad in their effects.

In all these works, besides the kind of fires which we have just mentioned, there may be introduced discharges of stars, of serpents, and of sky rockets, together with crackers or maroons, as well as occasional discharges of single stars. But the method of managing fires and effects of this nature, and the periods at which they may be introduced with advantage, have been mentioned already on other occasions so often, that we shall take no farther notice of them than by making this general suggestion, as it would lead us into long and useless details to mention them wherever they are applicable. Transparencies may also be combined with many of these. But, in general, the effect of these is sufficiently dull, unless where it is necessary to fill up intervals in a large building, or where allegorical devices are wanted for some particular object. We shall therefore leave all these matters to the discretion of the painter; noticing only one out of many, as a specimen of one of the most agreeable modes in which contrivances of this nature may be introduced.

As it would be impossible to give names to all the pieces which we are about to describe, and as they could not be rendered at all intelligible without the figures, we shall here refer to the numbers on the plates. Very little description will in fact be necessary, as these are matters which speak chiefly to the eye. We shall only add, that instead of giving solid drawings of the fireworks themselves, we have preferred what may rather be considered as plans or diagrams, both of them and of their effects. By these means they will be more intelligible than if the plates had been overloaded with work. In selecting the respective sizes, the artist must also be regulated by the magnitude and nature of his operations; as he may further be in multiplying the cases of fire; since we have avoided every thing that might crowd the drawings so as to render them unintelligible. The leaders are also omitted for the same reason. The methods of disposing these must already be very clear; and to have introduced them into the drawings would have caused inextricable confusion.

Description of the figures.
Plate CCCCLXXIV.
Fig. 16.

Fig. 16. The construction of this is very apparent from the drawing. The illumination lights may be varied, by being made alternately blue and white.

Fig. 17.

Fig. 17. The object of this is also plain. The wheels may be simple, or else they may inclose a pointed star, as shown on one of them. A star may also be placed at the intersection of the central cases. In this and similar fireworks it is best to introduce the central fires after the wheels have burnt one or two cases.

Figs. 18, 19.

Figs. 18, 19. This is intended as a specimen of what may be effected by means of transparencies. We have, however, chosen a very simple and common-place disposition of the star, which may be varied in numerous ways; as, for example, by using circular intersections, or by imitating any stars of orders of knighthood, or in many other ways. Whichever mode of drawing is adopted, there must be one star within another, painted in different colours and designs, and as transparent as possible. Behind this is placed the double alternating wheel formerly described, and the diameter of the two must be so regulated that one may cover with its fire the outer star, and the other the inner. Thus when these burn alternately, the star will appear to diminish and to enlarge at intervals. Its beauty may be much improved by adding to it an outer star of lights, as indicated in the figure.

Figs. 20, 21.

Figs. 20, 21. The nature of this firework is also intelligible; and it may be varied in many other ways besides the two which are here given.

Fig. 22.

Fig. 22. This is a pointed star of fixed lights, which may be modified in many ways, by altering the proportions and the number of the rays. The same figure shows three modes of doing this, out of many others that might be suggested. Inside it may carry one wheel or two; and besides this, a pointed star may also be placed in the centre.

Fig. 23.

Fig. 23. Not to multiply figures, this one represents three or four modes, or more, of combining wheels, all of which produce very brilliant effects. Six small wheels may be placed on arms, at a considerable distance from a larger central one. These arms may also be ornamented with single or with double rows of lights. One or two small wheels may also be carried round with the larger, so as to produce the flourishing curve either inside or outside of it. Or, lastly, it is represented as carrying a star in the middle. More varieties might easily be introduced, but the artist may select enough among these. If the whole should be adopted, the effect will be extremely splendid; but in this case it will be necessary to adopt a large scale, to prevent the different fires from being too much crowded.

Fig. 24.

Fig. 24. This is a very splendid disposition of fire, which may also be varied in different ways, as represented in the same figure. It is in the first place a pyramid of wheels, with intermediate cases. Care must be taken to place them so that they may throw fires clear of the circles performed by the wheels. The arms may be illuminated or not, and there may also be stars at the intersections. This machine may be treated on the principle of mutation. Thus the

lights may first be fired, afterwards the wheels, and last of all the fixed cases.

Plate CCCCLXXIV. Fig. 25. Fig. 25. This also is a very splendid firework, but it requires to be made on a very large scale. It may also be a piece of mutation, as the fixed cases may fire when the wheels are partly expended. The wheels should diminish gradually in diameter in ascending, while at the same time they have the same duration. This is very easily managed, by placing the cases in somewhat of a spiral manner. Thus if a hexagon form be used at the bottom, the next may be a pentagon, with a case overlapping, and so on to the top; and as the same kinds of cases will be used in all, they will burn together. Wheels are easily timed without this, in many ways in which we need not now point out, as all the general principles must by this time be well understood.

Fig 26. Fig. 26. The nature of this is too obvious to require explanation. It might easily become confused if care was not taken to keep all the parts well asunder. It is rather too formal for beauty, unless it were to form a part of some other larger design.

Fig. 27. Fig. 27. This may be made extremely brilliant, but it requires a great deal of room. In constructing it, care must be taken that all the cases should be placed at the various angles indicated in the drawing, that a proper distribution of the brilliant fire may take place. The branches may be illuminated or not, as represented in different parts of the drawing. If illuminated, it should be made a mutation piece, by not bringing the brilliant cases into action till the wheel is partly expended.

Fig. 28. Fig. 28. This is a piece to be found in the common books, and it is one of the very few good ones which they contain. It explains itself sufficiently; and it will also be seen that it admits of modification, by the introduction or omission of the lights and stars. But the best form of it is to fire the lights first, the wheel afterwards, and last of all the diverging cases at the extremity, which may be made of the same length and quality as the last case of the wheel, so that they may commence and terminate with it.

Fig. 29. Fig. 29. This is a very handsome form of star, in any of the two or three shapes that are represented on the same figure. Care must be taken that the wheel do not throw its fires beyond the centre, so as to confuse the illuminations. It should also be managed on the principle of mutation, that the fires at the extremities may not burn till the last case of the wheel.

Fig. 30. Fig. 30. This is a very handsome, but a complicated firework; nor can it be moved without machinery. It is true that the books direct wheels to be placed at the feet of the cases, but the consequence of this is to produce confusion, and spoil the effect. The cones are made to revolve on spindles, in the same direction, so as to produce the appearance of a spiral motion. In the figure, a star is represented in the centre, with brilliant fires in the intervals of the cones; but these parts may be varied in many different ways, as by the substitution of a wheel in the centre. The machine that is required for moving this firework is simple enough, as it is only a contrate oblique wheel, moved by a winch or a weight, and acting on the endless screws which carry the cones, and form their axes.

Fig. 31. Fig. 31. This is a piece of architecture of a Gothic design; and we shall here remark, generally, that the Gothic, Chinese, and Oriental, or Arabic and Indian styles, are best adapted to fireworks, on account of the scope they allow to the fancy. Greek architecture is generally heavy and dull in fireworks; while the artist is at the same time tied down to rules which are difficult to follow in this manner, and which ought not to be neglected. We have here represented only one of many ways in which the fires on such a figure as this may be varied; and here also it is recommended that the cases of brilliant fire which represent the crockets should not be lighted till the last.

Plate CCCCLXXV. Fig. 27. This is a design on a very small scale, in a sort of oriental style. It will be sufficient if the dome is represented only in front, or that the hinder part be omitted; but it may also be done with very little difference as to the effect, on a plane. The columns, which are twisted, may, if the artist thinks fit, be moved by machinery so as to represent each a moving spiral. Large lights may be used on the ends of the capitals, with or without a star in the middle. The front admits of many modifications, though we have given only a wheel with four stars.

Plate CCCCLXXXIV. Fig. 32. This is not so much calculated to stand alone as to form a part of some other general design. The spiral columns carry the sort of illuminated globes formerly described; and they may be extended to more. When pairs of spiral columns are made to revolve in this way, it has a better effect if the direction of their motions are reversed. This piece is particularly adapted for mutations, but we need not encumber our figure with them.

Fig. 33. This represents another variety of architecture, in which the forms of trees are combined with those of a building. The simplest idea is here represented, but it may be multiplied and varied with great ease. The cases which are to form the branches of the palm tree, should not be lighted till the end, so that it will first represent a piece of simple architecture.

Plate CCCCLXXV. Fig. 28. This is another specimen in an oriental style, of which the very simplest idea alone is given. It requires no other explanation than such as have been given for the preceding ones.

Plate CCCCLXXV. Fig. 29. This is intended to represent a Chinese pagoda, but is only applicable to works on a very large scale. The whole of the architectural lines must be defined by rows of lights; and the bells which ornament the extremities of the intermediate roofs must consist of large ones. Wheels of diminishing sizes upwards may be introduced into the several stories. It may also terminate by discharges of brilliant fire from various parts of the building, and very conveniently by sky rockets; but we have not thought it necessary to crowd the figure with these.

Plate CCCCLXXV. Fig. 30. This is intended to represent the mode in which a light colonnade may be managed; but we need not describe the variety of fires and ornaments which it admits, as our intention has only been to give a general notice of the nature of the design. The lights should appear to hang upon lines, so as to form the catenarian curves. But, as this cannot actually be done upon real lines, on account of their unsteadiness, these curves should be drawn upon the frames; which is easily done by following with a bit of chalk the line which a heavy rope makes upon them when suspended in the proper places.

Plate CCCCLXXIII. Fig. 25. This is a complicated figure with wheels, intended to act as a mutation piece. The lights are succeeded by the wheels, and these by the diverging cases. It requires a great deal of room; and the wheels on the stem should be small, that they may not interfere too much with the illuminations.

Plate CCCCLXXIII. Fig. 26. This is a combination of wheels with stars and brilliant cases, which is also intended to show three changes. The stars are first lighted, then the wheels, and lastly the cases. On one of the arms, which is prolonged for that purpose, lights are placed, by adopting which plan a distinct firework is produced; and if this be used, all the lights and stars must be fired at the same time; and the others as before, in succession.

Plate CCCCLXXIII. Fig. 27. This is intended to represent one of numerous modes that might have been given, of forming a single mutable column, which may conveniently be exhibited alone, or may form a centre for other smaller works. All the lines of the pillar, the capital, and the pedestal, are formed by lights; and two large lights, with an intermediate star or not, may be used for the volutes of the capital. In this way the pillar is first lighted. The first mutation consists in lighting a wheel upon the pedestal, and the last in firing the fixed cases on its angles, and the fountain upon its summit.

Plate CCCCLXXIII. Fig. 28. We shall terminate this section, which might have been indefinitely prolonged, by a plan for a simple colonnade, which also performs three mutations. It explains itself without assistance. The lights are succeeded by the wheels, and these by the cases at the summit; and single cases are here used for the purpose of producing a piece of light appearance. In all these mutations, care must be taken that the lights may continue till every thing else is burnt out. These are, of course, measured to burn the whole wheel, and somewhat more; while the lighting of the last case of the wheel gives the signal to the artist to apply the fire to the last mutation, for which there must be always a separate leader. The wheels are lighted from a hole made in some case of light, which is near at hand; the time of which has been previously so calculated that all which remains unburnt from that point may exactly equal the whole wheel in duration. Thus the artist will have no further trouble during the burning than to watch the time when the last case of the wheel takes fire.

Mutation Pieces.

It is a necessary system in all fireworks, to produce successive changes, and particularly on the large scale, when it is intended to continue an exhibition for some hours perhaps. On a small scale, it is also required; but in such cases, the changes are commonly limited to three or four, as they are generally all accomplished within the course of a quarter of an hour. The books contain many projects of this kind, even on the small scale: while they also pretend to perform ten or twelve mutations in one piece, and that, not only in a fixed but in a moving one. We have no hesitation in saying, that this is impossible, and that many of the drawings which have been given for this purpose cannot be executed. It is not possible to unite so many discordant parts, which are all to move, in any manner, so that they shall act properly. The weight becomes as unmanageable as the complication; so that the parts are brought to a state of rest, or else they confuse each other in the effect, or lastly, some of them take fire before their time, from the difficulty of keeping so many leaders safe and separate. Besides, it must be recollected that no wheel will set fire to any thing else; so that whenever a firework of this kind comes into the series of changes, the operator must be always on the watch, not only to light a fresh leader, but to take care that he does not mistake one for another.

Nor is there any advantage in thus combining pieces together in this intricate manner, as all that is gained by it, even when it succeeds, is to exhibit a fresh piece in the same place; whereas the effect is as good if it be done at one side, or above, or below, which it may easily be on a separate framework, and with a distinct arrangement of leaders. We therefore dissuade our readers from these attempts, and recommend them to limit their mutations for moving fireworks, to two or three, and for the smaller kinds of fixed ones to three or four, or at most five.

As we have now, under the preceding heads, shown how the pieces for which we have given plans may be fixed, either all at once or according to an order of two, or three, or more successions, we shall not here give any further drawings of that nature, as it would require more plates than are compatible with the necessary extent of this article. On reconsidering the designs that have been given, an artist will see that there is scarcely one of them that will not admit of two or three changes more than we have represented, but which we omitted, that we might not encumber and confuse the drawings. We do not, therefore, think it necessary to give any more of these for that purpose, but shall content ourselves with giving two sets of drawings, one of merely ornamental fires, and the other of architectural constructions, as specimens of what may be done in this way.

Plate CCCCLXXV. Figs. 1—20.

The drawings, indeed, so far explain themselves, that scarcely any other remarks are necessary beyond those which we have already made. But we must observe respecting the first, that although we have given twelve changes for a circular figure, all the fires required for them cannot be attached to one frame, for want of room. These are rather intended as specimens of what may be done in this way, than as a recommendation to be followed. The artist may select any four or six, according to his taste; and he will even find these abundantly difficult to manage on one frame. If the whole should, however, be required to appear in the same place, separate frames should be provided, and so adapted that the front one may easily be removed, to expose that behind it.

Figs. 21—26.

The six mutations that are given for the architectural plan, may easily be effected on one building; because there is always plenty of room in a frame of this kind. We might even have introduced more, but we thought it unnecessary.

We have here also introduced a simple form of Greek design; but any of the designs formerly given may be treated in the same manner, and even with more variety.

We need, lastly, only remark, that each successive drawing, in both these examples, represents a fresh mutation; and that, in executing and disposing them, a judicious artist will take care that they should always increase in brilliancy till the last.

We shall, therefore, dismiss this part of our subject without further description, trusting that the drawings will sufficiently explain themselves.

Of Aquatic Fireworks.

Of aquatic fireworks.

We do not think it necessary to make a separate head for this article, as is commonly done; since, for the most part, these differ in no respect from fireworks burnt on the land.

We have already treated particularly of the common water rocket; and have also, under the different heads of wheels and exploding pots, shown how they may be

Pyrotechny.

lights may first be fired, afterwards the wheels, and last of all the fixed cases.

PLATE CCCCLXXIV. Fig. 25.

Fig. 25. This also is a very splendid firework, but it requires to be made on a very large scale. It may also be a piece of mutation, as the fixed cases may fire when the wheels are partly expended. The wheels should diminish gradually in diameter in ascending, while at the same time they have the same duration. This is very easily managed, by placing the cases in somewhat of a spiral manner. Thus if a hexagon form be used at the bottom, the next may be a pentagon, with a case overlapping, and so on to the top; and as the same kinds of cases will be used in all, they will burn together. Wheels are easily timed without this, in many ways in which we need not now point out, as all the general principles must by this time be well understood.

Fig 26.

Fig. 26. The nature of this is too obvious to require explanation. It might easily become confused if care was not taken to keep all the parts well asunder. It is rather too formal for beauty, unless it were to form a part of some other larger design.

Fig. 27.

Fig. 27. This may be made extremely brilliant, but it requires a great deal of room. In constructing it, care must be taken that all the cases should be placed at the various angles indicated in the drawing, that a proper distribution of the brilliant fire may take place. The branches may be illuminated or not, as represented in different parts of the drawing. If illuminated, it should be made a mutation piece, by not bringing the brilliant cases into action till the wheel is partly expended.

Fig. 28.

Fig. 28. This is a piece to be found in the common books, and it is one of the very few good ones which they contain. It explains itself sufficiently; and it will also be seen that it admits of modification, by the introduction or omission of the lights and stars. But the best form of it is to fire the lights first, the wheel afterwards, and last of all the diverging cases at the extremity, which may be made of the same length and quality as the last case of the wheel, so that they may commence and terminate with it.

Fig. 29.

Fig. 29. This is a very handsome form of star, in any of the two or three shapes that are represented on the same figure. Care must be taken that the wheel do not throw its fires beyond the centre, so as to confuse the illuminations. It should also be managed on the principle of mutation, that the fires at the extremities may not burn till the last case of the wheel.

Fig. 30.

Fig. 30. This is a very handsome, but a complicated firework; nor can it be moved without machinery. It is true that the books direct wheels to be placed at the feet of the cases, but the consequence of this is to produce confusion, and spoil the effect. The cones are made to revolve on spindles, in the same direction, so as to produce the appearance of a spiral motion. In the figure, a star is represented in the centre, with brilliant fires in the intervals of the cones; but these parts may be varied in many different ways, as by the substitution of a wheel in the centre. The machine that is required for moving this firework is simple enough, as it is only a contrate oblique wheel, moved by a winch or a weight, and acting on the endless screws which carry the cones, and form their axes.

Fig. 31.

Fig. 31. This is a piece of architecture of a Gothic design; and we shall here remark, generally, that the Gothic, Chinese, and Oriental, or Arabic and Indian styles, are best adapted to fireworks, on account of the scope they allow to the fancy. Greek architecture is generally heavy and dull in fireworks; while the artist is at the same time tied down to rules which are difficult to follow in this manner, and which ought not to be neglected. We have here represented only one of many ways in which the fires on such a figure as this may be varied; and here also it is recommended that the cases of brilliant fire which represent the crockets should not be lighted till the last.

Plate CCCCLXXV. Fig. 27. This is a design on a very small scale, in a sort of oriental style. It will be sufficient if the dome is represented only in front, or that the hinder part be omitted; but it may also be done with very little difference as to the effect, on a plane. The columns, which are twisted, may, if the artist thinks fit, be moved by machinery so as to represent each a moving spiral. Large lights may be used on the ends of the capitals, with or without a star in the middle. The front admits of many modifications, though we have given only a wheel with four stars.

Plate CCCCLXXIV. Fig. 32. This is not so much calculated to stand alone as to form a part of some other general design. The spiral columns carry the sort of illuminated globes formerly described; and they may be extended to more. When pairs of spiral columns are made to revolve in this way, it has a better effect if the direction of their motions are reversed. This piece is particularly adapted for mutations, but we need not encumber our figure with them.

Fig. 33. This represents another variety of architecture, in which the forms of trees are combined with those of a building. The simplest idea is here represented, but it may be multiplied and varied with great ease. The cases which are to form the branches of the palm tree, should not be lighted till the end, so that it will first represent a piece of simple architecture.

Plate CCCCLXXV. Fig. 28. This is another specimen in an oriental style, of which the very simplest idea alone is given. It requires no other explanation than such as have been given for the preceding ones.

Plate CCCCLXXV. Fig. 29. This is intended to represent a Chinese pagoda, but is only applicable to works on a very large scale. The whole of the architectural lines must be defined by rows of lights; and the bells which ornament the extremities of the intermediate roofs must consist of large ones. Wheels of diminishing sizes upwards may be introduced into the several stories. It may also terminate by discharges of brilliant fire from various parts of the building, and very conveniently by sky rockets; but we have not thought it necessary to crowd the figure with these.

Plate CCCCLXXV. Fig. 30. This is intended to represent the mode in which a light colonnade may be managed; but we need not describe the variety of fires and ornaments which it admits, as our intention has only been to give a general notice of the nature of the design. The lights should appear to hang upon lines, so as to form the catenarian curves. But, as this cannot actually be done upon real lines, on account of their unsteadiness, these curves should be drawn upon the frames; which is easily done by following with a bit of chalk the line which a heavy rope makes upon them when suspended in the proper places.

Plate CCCCLXXIII. Fig. 25. This is a complicated figure with wheels, intended to act as a mutation piece. The lights are succeeded by the wheels, and these by the diverging cases. It requires a great deal of room; and the wheels on the stem should be small, that they may not interfere too much with the illuminations.

Plate CCCCLXXIII. Fig. 26. This is a combination of wheels with stars and brilliant cases, which is also intended to show three changes. The stars are first lighted, then the wheels, and lastly the cases. On one of the arms, which is prolonged for that purpose, lights are placed, by adopting which plan a distinct firework is produced; and if this be used, all the lights and stars must be fired at the same time; and the others as before, in succession.

Plate CCCCLXXIII. Fig. 27. This is intended to represent one of numerous modes that might have been given, of forming a single mutable column, which may conveniently be exhibited alone, or may form a centre for other smaller works. All the lines of the pillar, the capital, and the pedestal, are formed by lights; and two large lights, with an intermediate star or not, may be used for the volutes of the capital. In this way the pillar is first lighted. The first mutation consists in lighting a wheel upon the pedestal, and the last in firing the fixed cases on its angles, and the fountain upon its summit.

Plate CCCCLXXIII. Fig. 28. We shall terminate this section, which might have been indefinitely prolonged, by a plan for a simple colonnade, which also performs three mutations. It explains itself without assistance. The lights are succeeded by the wheels, and these by the cases at the summit; and single cases are here used for the purpose of producing a piece of light appearance. In all these mutations, care must be taken that the lights may continue till every thing else is burnt out. These are, of course, measured to burn the whole wheel, and somewhat more; while the lighting of the last case of the wheel gives the signal to the artist to apply the fire to the last mutation, for which there must be always a separate leader. The wheels are lighted from a hole made in some case of light, which is near at hand; the time of which has been previously so calculated that all which remains unburnt from that point may exactly equal the whole wheel in duration. Thus the artist will have no further trouble during the burning than to watch the time when the last case of the wheel takes fire.

Mutation Pieces.

It is a necessary system in all fireworks, to produce successive changes, and particularly on the large scale, when it is intended to continue an exhibition for some hours perhaps. On a small scale, it is also required; but in such cases, the changes are commonly limited to three or four, as they are generally all accomplished within the course of a quarter of an hour. The books contain many projects of this kind, even on the small scale: while they also pretend to perform ten or twelve mutations in one piece, and that, not only in a fixed but in a moving one. We have no hesitation in saying, that this is impossible, and that many of the drawings which have been given for this purpose cannot be executed. It is not possible to unite so many discordant parts, which are all to move, in any manner, so that they shall act properly. The weight becomes as unmanageable as the complication; so that the parts are brought to a state of rest, or else they confuse each other in the effect, or lastly, some of them take fire before their time, from the difficulty of keeping so many leaders safe and separate. Besides, it must be recollected that no wheel will set fire to any thing else; so that whenever a firework of this kind comes into the series of changes, the operator must be always on the watch, not only to light a fresh leader, but to take care that he does not mistake one for another.

Nor is there any advantage in thus combining pieces together in this intricate manner, as all that is gained by it, even when it succeeds, is to exhibit a fresh piece in the same place; whereas the effect is as good if it be done at one side, or above, or below, which it may easily be on a separate framework, and with a distinct arrangement of leaders. We therefore dissuade our readers from these attempts, and recommend them to limit their mutations for moving fireworks, to two or three, and for the smaller kinds of fixed ones to three or four, or at most five.

As we have now, under the preceding heads, shown how the pieces for which we have given plans may be fixed, either all at once or according to an order of two, or three, or more successions, we shall not here give any further drawings of that nature, as it would require more plates than are compatible with the necessary extent of this article. On reconsidering the designs that have been given, an artist will see that there is scarcely one of them that will not admit of two or three changes more than we have represented, but which we omitted, that we might not encumber and confuse the drawings. We do not, therefore, think it necessary to give any more of these for that purpose, but shall content ourselves with giving two sets of drawings, one of merely ornamental fires, and the other of architectural constructions, as specimens of what may be done in this way.

PLATE CCCCLXXV. Figs. 1—20.

The drawings, indeed, so far explain themselves, that scarcely any other remarks are necessary beyond those which we have already made. But we must observe respecting the first, that although we have given twelve changes for a circular figure, all the fires required for them cannot be attached to one frame, for want of room. These are rather intended as specimens of what may be done in this way, than as a recommendation to be followed. The artist may select any four or six, according to his taste; and he will even find these abundantly difficult to manage on one frame. If the whole should, however, be required to appear in the same place, separate frames should be provided, and so adapted that the front one may easily be removed, to expose that behind it.

Figs. 21—26.

The six mutations that are given for the architectural plan, may easily be effected on one building; because there is always plenty of room in a frame of this kind. We might even have introduced more, but we thought it unnecessary.

We have here also introduced a simple form of Greek design; but any of the designs formerly given may be treated in the same manner, and even with more variety.

We need, lastly, only remark, that each successive drawing, in both these examples, represents a fresh mutation; and that, in executing and disposing them, a judicious artist will take care that they should always increase in brilliancy till the last.

We shall, therefore, dismiss this part of our subject without further description, trusting that the drawings will sufficiently explain themselves.

Of Aquatic Fireworks.

Of aquatic fireworks.

We do not think it necessary to make a separate head for this article, as is commonly done; since, for the most part, these differ in no respect from fireworks burnt on the land.

We have already treated particularly of the common water rocket; and have also, under the different heads of wheels and exploding pots, shown how they may be

used on water, by means of proper floats. It only remains, therefore, to add a few words respecting those transparent figures for the water, which are recommended in the books of pyrotechny.

In this manner it has been attempted to represent water fowl, ships, and other more complicated figures; such as chariots with tritons and dolphins, and similar heathen devices. Such figures as this are, however, rather the business of the artist who constructs machinery for the theatres; and we shall, therefore, forbear to give any directions concerning them. They do not admit of much fire; and, generally speaking, their effects are very poor, when compared with the trouble and expence with which they are attended. An artist will, at any rate, find no difficulty in arranging in them such fireworks as they are capable of bearing: and it must also be left to his own judgment to place the communications in such a manner as shall best insure their proper performance.

In terminating this part of the subject, although somewhat out of place, we shall also point out the facility with which a paper kite may be converted into a firework, by disposing lights upon it, and setting these on fire when it is in the air, by means of a line rocket on its string. But a strong breeze of wind is necessary for this purpose, while it is also only applicable to objects of private amusement.

The Chinese Drum.

The Chinese drum.
PLATE CCCCLXXV.
Fig. 31.

This very entertaining and delicate firework is peculiar to the Chinese, and is described in terms of no small admiration, and of something like wonder, in Sir George Staunton's narrative. No account of its construction has yet been published, and as we have both dissected and imitated it, we are able to gratify the curiosity both of our readers and of the pyrotechnists. It will be necessary to consult the plate on this subject, as the description could not be rendered intelligible without that assistance.

In its external appearance, this machine resembles a drum, or a cylindrical bandbox, and is generally ornamented with paintings of various kinds, so as to give it a pleasing appearance. When it is to be fired, it is suspended from a proper stand, at a height of 12 or 15 feet, by means of a loop at the top, and is fired by means of a match at the lower end. Immediately there drops out below a transparent piece, accompanied by a firework of some kind, which, after it is burnt out, falls to the ground, and is succeeded by another object, but of a different nature, and so on in succession, until the whole is expended. The number or succession of these mutations may be unlimited, as it is quite as easy to insure the proper burning of a hundred as of two; but it is generally confined to ten or twelve.

These objects consist of castles, ships, lanterns, or other devices, which vary according to the fancy of the artist, and which we must leave, in a great measure, to the discretion of our own pyrotechnists, as we can only describe enough of them to convey an idea of the general principle. The effects are easily apprehended. If it be a lantern, for example, that first comes down, it is painted in transparency, with figures of men or animals, or with fruit or flowers, or with architectural patterns, or with any other objects according to the fancy of the operator. The colouring may also be varied; so that if there are two or more lanterns employed in one drum, they may be as different from each other as possible. They may in the same way vary in shape, so as to represent cylinders, or globes, or cones, or pyramids, or other figures, so as to produce an infinite variety. At the moment that such a lantern, if that be the object, falls down, it is illuminated within by means of a speckie, or illumination light; and as the colours of these may be varied, so the appearances of the firework are. There may further be two lights of different colours, the one to succeed the other, so that the varieties, of which the lantern alone is susceptible, are very great, even in its simplest form.

But it may also be further modified, by introducing fires of different kinds round its lower margin, such as small gerbes, or spur lights, or crackers, or serpents, or wheels. These are managed further in various ways, so as to fire in different successions; all of these being regulated by the general methods which we shall presently describe. In these several ways then, and by variously combining them, the number of appearances that the lantern may display is such, as, in the hands of an ingenious artist, to produce as much variety as can be desired.

Supposing now that this first figure, consisting thus of a lantern, is expended, as soon as it falls to the ground, perhaps two ships descend from the drum. These may also be varied in many ways, as to their forms and colours, and they are so managed as to engage each other. These also are made of transparent painted paper, properly supported, like the lantern, by a wooden framework. The guns consist of small crackers, disposed on the gunwales; and they may be further varied by carrying lights in the tops, or wheels at their sides or sterns, or by discharges of sky-rockets, which, for this purpose, are made no larger than the smallest goose quill. The form and the smoke of our own steam-boats might very appropriately be introduced in this manner. Single ships are also made use of, and then they are decorated with flags, illuminated with lights, and provided with rockets, wheels, crackers, and other emblems of rejoicing.

The next mutation may be a castle, and this also admits of much variety. It may be painted and lighted in various ways, and further provided with any of the different fireworks already mentioned. Or two castles may be made to engage each other, or else a ship may engage with a castle; all of these being conducted exactly on the same principles, and varied according to the taste and ingenuity of the artist. An illuminated pagoda offers another mode of mutation, as do houses, temples, and various objects which we need not enumerate. Animals may also be introduced. Thus, dragons or griffins may be caused to engage each other with fire, as may enchanters and fiery chariots; but we need not describe more of the figures and mutations that may be introduced into this very amusing firework. We will, therefore, proceed to describe the construction, as far as it can be rendered intelligible without actually examining the machine itself.

To make the case or including cylinder, as many hoops of ash or cane are required as there are mutations intended, and one more. The diameter of these depends on the intended size of the firework. It cannot conveniently be less than a foot and a half, and does not commonly exceed three. As it is difficult for an unpractised hand to succeed in making this machine on a small scale, it will be found convenient to adopt the larger sizes.

Supposing now that six mutations are required, the total length of the case or drum must be three feet, or somewhat more, if the diameter exceeds two feet. An

inexpert artist will find it convenient to take plenty of room in this direction, to enable him the easier to pack away his mutations; an expert Chinese will place in a depth of three inches what an English workman could not crowd into six. Seven hoops will be required for six mutations, that there may be six intervals, and they are then to be framed into a cylinder, by means of three flat uprights of similar light materials. A cross of the same description is to be made on the top of the cylinder for supporting the mutations, and for fixing the loop by which the drum is to hang when fired. Six inches or eight, if this firework is of a large size, will thus be left between each of the hoops. The whole of this frame-work may be fastened by means of string covered with a little glue. The case is then ready to receive its charge, as it cannot be covered with paper till that is arranged, and all the primings and conductors fixed. But as we need not recur to the case again, we shall here finish its description by saying, that when the whole of the mutations have been introduced and arranged, it is to be covered with stout cartridge paper, sufficiently strong to prevent accidents, all over, which may then be further covered with white paper and painted; or otherwise ornamented in any other manner that the artist may think proper.

The mode of making the mutations or transparent pieces is as follows: and we will first take the simplest case, that of a square lantern. Two squares of light wood, but strong, are framed for the top and bottom, in a firm manner, with glue; and these, particularly the bottom one, must have substance enough to bear the pins for supporting wheels. They are connected at the corners by strings, of the requisite length, so as to form a skeleton, and there is further a diagonal piece of wood, or a cross, as may be preferred, to be placed in the top and bottom; the upper one to support the connecting string by which the lantern hangs, and the lower to carry the illumination lights. The lantern is not to be finished till all the fireworks are settled and fixed ready for firing, in the manner we shall presently describe; after which it is to be covered with transparent paper, painted with dark colours, or with white paper, painted in transparent colours, such as those used for window blinds. This covering must be so thin as to allow the lantern to be pressed up, at least as close as the space which it is to occupy in the drum.

Towers, castles, ships, pagodas, &c. are all made on the same principles; and as we could not detail their construction to any useful purpose, they must be left to the ingenuity of the artist. It is only necessary to remember, that the transverse framing must always be sufficiently strong to carry the pins for wheels, or to support rockets, crackers, serpents outside, and lights within; and that the sides must be made of strings, to allow them to be packed up within the body of the case. The wooden part of a ship may be the gunwale and the keel; or if these are made narrow, they may be fully framed with their masts, and the necessary rigging, and laid on their sides in the case. The same practice may be adopted for dragons and such like objects; and, when necessary, a little more room may be allowed between the hoops for this class of transparencies. We need say nothing more on the method of painting and ornamenting all these figures or mutations. The general principle is the same in all; to use brilliant and transparent colouring, while in all other points the artist is free to follow his own taste. It is now necessary to describe the fireworks, and the method of attaching and disposing them about the transparencies.

Chinese drum.

All those figures that are large enough to contain one in their cavity, without risk of taking fire, are to be provided with an internal illumination light or speckie, which is to be properly fixed on the middle of the bottom frame. Ships, and such like objects, do not admit of this ornament. These fires are made according to the compositions described in another part of this article, and which we need not therefore repeat; and they may be varied by using different coloured lights, either in the same piece in succession, or in the different pieces. Before these are fixed in their places, they must be primed and furnished with a bit of quick match, and they are then ready to be introduced into the line of the communicating fire.

The wheels used for this purpose cannot well be made in the spiral form, as these occupy too much room. They are single case wheels, perforated in the middle, and bored with two lateral opposed holes at the extremities; but as the method of making these has also been described elsewhere, we need not repeat it. These wheels may be introduced in various ways, according to the taste of the artist; and, for example, if the object be a lantern, one may be fixed on each side of the bottom frame. The pin which carries them is firmly fastened into that part, and then they are laid parallel to it, and secured by two slips of very slight paper. These also must be properly primed with quick match, well secured, before any thing further is done.

Rows of crackers, made in the manner of the Chinese crackers elsewhere described, are fixed, by means of a bit of string or pasted paper, wherever they may be required. If in a ship, they are disposed round the gunwale; if in a castle, in the loop-holes, or on the battlements, and so on. Where dragons are to be used, a large cracker may be inclosed within the body, which is to be fired last of all. Serpents may be disposed in similar ways, but their heads must always be so directed that they may fly downwards, or out of the case, as they might otherwise get entangled in it above, and fire some of the movements before their time. This is an accident cautiously to be avoided throughout the whole construction of the machine, as it would entirely ruin the performance and spoil the effect. All these, like the former, must be primed before they are first fixed, as this is not so easily done afterwards.

The only other fires that can be introduced, are small gerbes, or spur lights; and these, like the others, may be fixed in any convenient places; always taking care that their fire be directed outwards, for the reason last mentioned. Sky-rockets, not exceeding an inch in length, may be fixed in some of the movements. Their sticks are made of a slender piece of slit bamboo; but they must be so disposed outward when the mutation piece falls, that they may fly off clear of the drum. An ingenious artist will easily find the means of managing this without any particular directions.

Supposing now all the pieces to be framed and provided with their several fires ready primed, a stout string is to be hung up to the ceiling of the artificer's room. From the top downwards a mark is made, as long as the drum, and about a foot or a foot and a half, or even two feet or more, according as the operator may wish the piece to descend more or less below it when it is lighted. The last or uppermost

used on water, by means of proper floats. It only remains, therefore, to add a few words respecting those transparent figures for the water, which are recommended in the books of pyrotechny.

In this manner it has been attempted to represent water fowl, ships, and other more complicated figures; such as chariots with tritons and dolphins, and similar heathen devices. Such figures as this are, however, rather the business of the artist who constructs machinery for the theatres; and we shall, therefore, forbear to give any directions concerning them. They do not admit of much fire; and, generally speaking, their effects are very poor, when compared with the trouble and expence with which they are attended. An artist will, at any rate, find no difficulty in arranging in them such fireworks as they are capable of bearing: and it must also be left to his own judgment to place the communications in such a manner as shall best insure their proper performance.

In terminating this part of the subject, although somewhat out of place, we shall also point out the facility with which a paper kite may be converted into a firework, by disposing lights upon it, and setting these on fire when it is in the air, by means of a line rocket on its string. But a strong breeze of wind is necessary for this purpose, while it is also only applicable to objects of private amusement.

The Chinese Drum.

The Chinese drum. Plate CCCCLXXV. Fig. 31.

This very entertaining and delicate firework is peculiar to the Chinese, and is described in terms of no small admiration, and of something like wonder, in Sir George Staunton's narrative. No account of its construction has yet been published, and as we have both dissected and imitated it, we are able to gratify the curiosity both of our readers and of the pyrotechnists. It will be necessary to consult the plate on this subject, as the description could not be rendered intelligible without that assistance.

In its external appearance, this machine resembles a drum, or a cylindrical bandbox, and is generally ornamented with paintings of various kinds, so as to give it a pleasing appearance. When it is to be fired, it is suspended from a proper stand, at a height of 12 or 15 feet, by means of a loop at the top, and is fired by means of a match at the lower end. Immediately there drops out below a transparent piece, accompanied by a firework of some kind, which, after it is burnt out, falls to the ground, and is succeeded by another object, but of a different nature, and so on in succession, until the whole is expended. The number or succession of these mutations may be unlimited, as it is quite as easy to insure the proper burning of a hundred as of two; but it is generally confined to ten or twelve.

These objects consist of castles, ships, lanterns, or other devices, which vary according to the fancy of the artist, and which we must leave, in a great measure, to the discretion of our own pyrotechnists, as we can only describe enough of them to convey an idea of the general principle. The effects are easily apprehended. If it be a lantern, for example, that first comes down, it is painted in transparency, with figures of men or animals, or with fruit or flowers, or with architectural patterns, or with any other objects according to the fancy of the operator. The colouring may also be varied; so that if there are two or more lanterns employed in one drum, they may be as different from each other as possible. They may in the same way vary in shape, so as to represent cylinders, or globes, or cones, or pyramids, or other figures, so as to produce an infinite variety. At the moment that such a lantern, if that be the object, falls down, it is illuminated within by means of a speckie, or illumination light; and as the colours of these may be varied, so the appearances of the firework are. There may further be two lights of different colours, the one to succeed the other, so that the varieties, of which the lantern alone is susceptible, are very great, even in its simplest form.

But it may also be further modified, by introducing fires of different kinds round its lower margin, such as small gerbes, or spur lights, or crackers, or serpents, or wheels. These are managed further in various ways, so as to fire in different successions; all of these being regulated by the general methods which we shall presently describe. In these several ways then, and by variously combining them, the number of appearances that the lantern may display is such, as, in the hands of an ingenious artist, to produce as much variety as can be desired.

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The mode of making the mutations or transparent pieces is as follows: and we will first take the simplest case, that of a square lantern. Two squares of light wood, but strong, are framed for the top and bottom, in a firm manner, with glue; and these, particularly the bottom one, must have substance enough to bear the pins for supporting wheels. They are connected at the corners by strings, of the requisite length, so as to form a skeleton, and there is further a diagonal piece of wood, or a cross, as may be preferred, to be placed in the top and bottom; the upper one to support the connecting string by which the lantern hangs, and the lower to carry the illumination lights. The lantern is not to be finished till all the fireworks are settled and fixed ready for firing, in the manner we shall presently describe; after which it is to be covered with transparent paper, painted with dark colours, or with white paper, painted in transparent colours, such as those used for window blinds. This covering must be so thin as to allow the lantern to be pressed up, at least as close as the space which it is to occupy in the drum.

Towers, castles, ships, pagodas, &c. are all made on the same principles; and as we could not detail their construction to any useful purpose, they must be left to the ingenuity of the artist. It is only necessary to remember, that the transverse framing must always be sufficiently strong to carry the pins for wheels, or to support rockets, crackers, serpents outside, and lights within; and that the sides must be made of strings, to allow them to be packed up within the body of the case. The wooden part of a ship may be the gunwale and the keel; or if these are made narrow, they may be fully framed with their masts, and the necessary rigging, and laid on their sides in the case. The same practice may be adopted for dragons and such like objects; and, when necessary, a little more room may be allowed between the hoops for this class of transparencies. We need say nothing more on the method of painting and ornamenting all these figures or mutations. The general principle is the same in all; to use brilliant and transparent colouring, while in all other points the artist is free to follow his own taste. It is now necessary to describe the fireworks, and the method of attaching and disposing them about the transparencies.

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All those figures that are large enough to contain one in their cavity, without risk of taking fire, are to be provided with an internal illumination light or speckie, which is to be properly fixed on the middle of the bottom frame. Ships, and such like objects, do not admit of this ornament. These fires are made according to the compositions described in another part of this article, and which we need not therefore repeat; and they may be varied by using different coloured lights, either in the same piece in succession, or in the different pieces. Before these are fixed in their places, they must be primed and furnished with a bit of quick match, and they are then ready to be introduced into the line of the communicating fire.

The wheels used for this purpose cannot well be made in the spiral form, as these occupy too much room. They are single case wheels, perforated in the middle, and bored with two lateral opposed holes at the extremities; but as the method of making these has also been described elsewhere, we need not repeat it. These wheels may be introduced in various ways, according to the taste of the artist; and, for example, if the object be a lantern, one may be fixed on each side of the bottom frame. The pin which carries them is firmly fastened into that part, and then they are laid parallel to it, and secured by two slips of very slight paper. These also must be properly primed with quick match, well secured, before any thing further is done.

Rows of crackers, made in the manner of the Chinese crackers elsewhere described, are fixed, by means of a bit of string or pasted paper, wherever they may be required. If in a ship, they are disposed round the gunwale; if in a castle, in the loop-holes, or on the battlements, and so on. Where dragons are to be used, a large cracker may be inclosed within the body, which is to be fired last of all. Serpents may be disposed in similar ways, but their heads must always be so directed that they may fly downwards, or out of the case, as they might otherwise get entangled in it above, and fire some of the movements before their time. This is an accident cautiously to be avoided throughout the whole construction of the machine, as it would entirely ruin the performance and spoil the effect. All these, like the former, must be primed before they are first fixed, as this is not so easily done afterwards.

The only other fires that can be introduced, are small gerbes, or spur lights; and these, like the others, may be fixed in any convenient places; always taking care that their fire be directed outwards, for the reason last mentioned. Sky-rockets, not exceeding an inch in length, may be fixed in some of the movements. Their sticks are made of a slender piece of slit bamboo; but they must be so disposed outward when the mutation piece falls, that they may fly off clear of the drum. An ingenious artist will easily find the means of managing this without any particular directions.

Supposing now all the pieces to be framed and provided with their several fires ready primed, a stout string is to be hung up to the ceiling of the artificer's room. From the top downwards a mark is made, as long as the drum, and about a foot or a foot and a half, or even two feet or more, according as the operator may wish the piece to descend more or less below it when it is lighted. The last or uppermost

used on water, by means of proper floats. It only remains, therefore, to add a few words respecting those transparent figures for the water, which are recommended in the books of pyrotechny.

In this manner it has been attempted to represent water fowl, ships, and other more complicated figures; such as chariots with tritons and dolphins, and similar heathen devices. Such figures as this are, however, rather the business of the artist who constructs machinery for the theatres; and we shall, therefore, forbear to give any directions concerning them. They do not admit of much fire; and, generally speaking, their effects are very poor, when compared with the trouble and expence with which they are attended. An artist will, at any rate, find no difficulty in arranging in them such fireworks as they are capable of bearing: and it must also be left to his own judgment to place the communications in such a manner as shall best insure their proper performance.

In terminating this part of the subject, although somewhat out of place, we shall also point out the facility with which a paper kite may be converted into a firework, by disposing lights upon it, and setting these on fire when it is in the air, by means of a line rocket on its string. But a strong breeze of wind is necessary for this purpose, while it is also only applicable to objects of private amusement.

The Chinese Drum.

The Chinese drum. Plate CCCCLXXV. Fig. 31.

This very entertaining and delicate firework is peculiar to the Chinese, and is described in terms of no small admiration, and of something like wonder, in Sir George Staunton's narrative. No account of its construction has yet been published, and as we have both dissected and imitated it, we are able to gratify the curiosity both of our readers and of the pyrotechnists. It will be necessary to consult the plate on this subject, as the description could not be rendered intelligible without that assistance.

In its external appearance, this machine resembles a drum, or a cylindrical bandbox, and is generally ornamented with paintings of various kinds, so as to give it a pleasing appearance. When it is to be fired, it is suspended from a proper stand, at a height of 12 or 15 feet, by means of a loop at the top, and is fired by means of a match at the lower end. Immediately there drops out below a transparent piece, accompanied by a firework of some kind, which, after it is burnt out, falls to the ground, and is succeeded by another object, but of a different nature, and so on in succession, until the whole is expended. The number or succession of these mutations may be unlimited, as it is quite as easy to insure the proper burning of a hundred as of two; but it is generally confined to ten or twelve.

These objects consist of castles, ships, lanterns, or other devices, which vary according to the fancy of the artist, and which we must leave, in a great measure, to the discretion of our own pyrotechnists, as we can only describe enough of them to convey an idea of the general principle. The effects are easily apprehended. If it be a lantern, for example, that first comes down, it is painted in transparency, with figures of men or animals, or with fruit or flowers, or with architectural patterns, or with any other objects according to the fancy of the operator. The colouring may also be varied; so that if there are two or more lanterns employed in one drum, they may be as different from each other as possible. They may in the same way vary in shape, so as to represent cylinders, or globes, or cones, or pyramids, or other figures, so as to produce an infinite variety. At the moment that such a lantern, if that be the object, falls down, it is illuminated within by means of a speckie, or illumination light; and as the colours of these may be varied, so the appearances of the firework are. There may further be two lights of different colours, the one to succeed the other, so that the varieties, of which the lantern alone is susceptible, are very great, even in its simplest form.

But it may also be further modified, by introducing fires of different kinds round its lower margin, such as small gerbes, or spur lights, or crackers, or serpents, or wheels. These are managed further in various ways, so as to fire in different successions; all of these being regulated by the general methods which we shall presently describe. In these several ways then, and by variously combining them, the number of appearances that the lantern may display is such, as, in the hands of an ingenious artist, to produce as much variety as can be desired.

Supposing now that this first figure, consisting thus of a lantern, is expended, as soon as it falls to the ground, perhaps two ships descend from the drum. These may also be varied in many ways, as to their forms and colours, and they are so managed as to engage each other. These also are made of transparent painted paper, properly supported, like the lantern, by a wooden framework. The guns consist of small crackers, disposed on the gunwales; and they may be further varied by carrying lights in the tops, or wheels at their sides or sterns, or by discharges of sky-rockets, which, for this purpose, are made no larger than the smallest goose quill. The form and the smoke of our own steam-boats might very appropriately be introduced in this manner. Single ships are also made use of, and then they are decorated with flags, illuminated with lights, and provided with rockets, wheels, crackers, and other emblems of rejoicing.

The next mutation may be a castle, and this also admits of much variety. It may be painted and lighted in various ways, and further provided with any of the different fireworks already mentioned. Or two castles may be made to engage each other, or else a ship may engage with a castle; all of these being conducted exactly on the same principles, and varied according to the taste and ingenuity of the artist. An illuminated pagoda offers another mode of mutation, as do houses, temples, and various objects which we need not enumerate. Animals may also be introduced. Thus, dragons or griffins may be caused to engage each other with fire, as may enchanters and fiery chariots; but we need not describe more of the figures and mutations that may be introduced into this very amusing firework. We will, therefore, proceed to describe the construction, as far as it can be rendered intelligible without actually examining the machine itself.

To make the case or including cylinder, as many hoops of ash or cane are required as there are mutations intended, and one more. The diameter of these depends on the intended size of the firework. It cannot conveniently be less than a foot and a half, and does not commonly exceed three. As it is difficult for an unpractised hand to succeed in making this machine on a small scale, it will be found convenient to adopt the larger sizes.

Supposing now that six mutations are required, the total length of the case or drum must be three feet, or somewhat more, if the diameter exceeds two feet. An

inexpert artist will find it convenient to take plenty of room in this direction, to enable him the easier to pack away his mutations; an expert Chinese will place in a depth of three inches what an English workman could not crowd into six. Seven hoops will be required for six mutations, that there may be six intervals, and they are then to be framed into a cylinder, by means of three flat uprights of similar light materials. A cross of the same description is to be made on the top of the cylinder for supporting the mutations, and for fixing the loop by which the drum is to hang when fired. Six inches or eight, if this firework is of a large size, will thus be left between each of the hoops. The whole of this frame-work may be fastened by means of string covered with a little glue. The case is then ready to receive its charge, as it cannot be covered with paper till that is arranged, and all the primings and conductors fixed. But as we need not recur to the case again, we shall here finish its description by saying, that when the whole of the mutations have been introduced and arranged, it is to be covered with stout cartridge paper, sufficiently strong to prevent accidents, all over, which may then be further covered with white paper and painted; or otherwise ornamented in any other manner that the artist may think proper.

The mode of making the mutations or transparent pieces is as follows: and we will first take the simplest case, that of a square lantern. Two squares of light wood, but strong, are framed for the top and bottom, in a firm manner, with glue; and these, particularly the bottom one, must have substance enough to bear the pins for supporting wheels. They are connected at the corners by strings, of the requisite length, so as to form a skeleton, and there is further a diagonal piece of wood, or a cross, as may be preferred, to be placed in the top and bottom; the upper one to support the connecting string by which the lantern hangs, and the lower to carry the illumination lights. The lantern is not to be finished till all the fireworks are settled and fixed ready for firing, in the manner we shall presently describe; after which it is to be covered with transparent paper, painted with dark colours, or with white paper, painted in transparent colours, such as those used for window blinds. This covering must be so thin as to allow the lantern to be pressed up, at least as close as the space which it is to occupy in the drum.

Towers, castles, ships, pagodas, &c. are all made on the same principles; and as we could not detail their construction to any useful purpose, they must be left to the ingenuity of the artist. It is only necessary to remember, that the transverse framing must always be sufficiently strong to carry the pins for wheels, or to support rockets, crackers, serpents outside, and lights within; and that the sides must be made of strings, to allow them to be packed up within the body of the case. The wooden part of a ship may be the gunwale and the keel; or if these are made narrow, they may be fully framed with their masts, and the necessary rigging, and laid on their sides in the case. The same practice may be adopted for dragons and such like objects; and, when necessary, a little more room may be allowed between the hoops for this class of transparencies. We need say nothing more on the method of painting and ornamenting all these figures or mutations. The general principle is the same in all; to use brilliant and transparent colouring, while in all other points the artist is free to follow his own taste. It is now necessary to describe the fireworks, and the method of attaching and disposing them about the transparencies.

Chinese drum.

All those figures that are large enough to contain one in their cavity, without risk of taking fire, are to be provided with an internal illumination light or speckie, which is to be properly fixed on the middle of the bottom frame. Ships, and such like objects, do not admit of this ornament. These fires are made according to the compositions described in another part of this article, and which we need not therefore repeat; and they may be varied by using different coloured lights, either in the same piece in succession, or in the different pieces. Before these are fixed in their places, they must be primed and furnished with a bit of quick match, and they are then ready to be introduced into the line of the communicating fire.

The wheels used for this purpose cannot well be made in the spiral form, as these occupy too much room. They are single case wheels, perforated in the middle, and bored with two lateral opposed holes at the extremities; but as the method of making these has also been described elsewhere, we need not repeat it. These wheels may be introduced in various ways, according to the taste of the artist; and, for example, if the object be a lantern, one may be fixed on each side of the bottom frame. The pin which carries them is firmly fastened into that part, and then they are laid parallel to it, and secured by two slips of very slight paper. These also must be properly primed with quick match, well secured, before any thing further is done.

Rows of crackers, made in the manner of the Chinese crackers elsewhere described, are fixed, by means of a bit of string or pasted paper, wherever they may be required. If in a ship, they are disposed round the gunwale; if in a castle, in the loop-holes, or on the battlements, and so on. Where dragons are to be used, a large cracker may be inclosed within the body, which is to be fired last of all. Serpents may be disposed in similar ways, but their heads must always be so directed that they may fly downwards, or out of the case, as they might otherwise get entangled in it above, and fire some of the movements before their time. This is an accident cautiously to be avoided throughout the whole construction of the machine, as it would entirely ruin the performance and spoil the effect. All these, like the former, must be primed before they are first fixed, as this is not so easily done afterwards.

The only other fires that can be introduced, are small gerbes, or spur lights; and these, like the others, may be fixed in any convenient places; always taking care that their fire be directed outwards, for the reason last mentioned. Sky-rockets, not exceeding an inch in length, may be fixed in some of the movements. Their sticks are made of a slender piece of slit bamboo; but they must be so disposed outward when the mutation piece falls, that they may fly off clear of the drum. An ingenious artist will easily find the means of managing this without any particular directions.

Supposing now all the pieces to be framed and provided with their several fires ready primed, a stout string is to be hung up to the ceiling of the artificer's room. From the top downwards a mark is made, as long as the drum, and about a foot or a foot and a half, or even two feet or more, according as the operator may wish the piece to descend more or less below it when it is lighted. The last or uppermost

Chinese drum.

piece is then fastened to it, so as to hang freely; after which it is conducted down through the middle of this piece to the next, and so on in succession, till they are all strung upon it at such distances as to permit each piece to fall, when detached, to the same distance below the drum. As to do all this at once requires a lofty room, the upper ones may be put away, while the lower are fastened on.

It is next necessary to prime the whole piece, that it may continue to burn from one end to the other, without more lighting, and that every firework in it may take fire at the proper time. This is the part which requires the principal care and attention on the part of the artificer, as failure or success entirely depends on it. The method of doing it is by a cotton slow match, so calculated for length and rapidity of burning, that the part which reaches from the bottom of one piece to that of the next, may occupy just as much time as the fireworks of that piece require to burn out. This is a point which must be ascertained by trial. The main leader of this cotton match runs along the central string, which is filled and covered with alum and paste to prevent it from burning.

From this central conductor, branch off the various matches which are to light the fires. Some of these are made of quick match, as is the case for the illumination central lights. Where a line of crackers are to be fired as guns, they are made of slow match, as they also are for the wheels, which are generally lighted towards the end of the piece. But all these are discretionary matters, about which the artist must follow his own views, and which he may arrange in any manner he thinks proper. It is only essential to remember, that all the conductors and priming must be made sure, and to take care that the main conductor continues to burn regularly.

All these things then being satisfactorily arranged, the pieces may be covered with their papers, and painted and ornamented, as was before mentioned, when the whole is ready to be packed up into the drum. To do this, four strong strings are fixed to each hoop, at right angles; each of them having a loop at the end, so that when brought together they all meet in the centre. Thus the case may be divided into as many compartments as there are hoops or pieces to be fired. When strings of this kind have thus been fixed to each hoop, the case is placed on the floor with its head downwards, and the first piece is packed into its proper compartment, taking care that it can be pulled out again easily without disturbing any part, and so as that it may easily resume its proper shape. This being done, the loops that belong to the first, or lowest set of strings, are brought together, and tied firmly with a piece of cotton quick match, which is also connected with the slow match of the main conductor. The same operation being performed for each piece in succession, the drum is completed and ready for covering with cartridge paper, as formerly mentioned. The bottom is also covered in the same manner; but this part must be cut out by a knife before the piece is fired. It is evident that while any one piece is down and burning, the cotton match is slowly conducting fire to the next above. When it reaches the quick match by which the strings that form each diaphragm are united, that gives way, and then another piece descends, and so on in succession to the last. We have no doubt that from these directions, an ingenious artist will find no difficulty in constructing the Chinese drum.

Tables of Compositions.

We shall now subjoin the table of compositions so often referred to, on which we have taken the liberty of making several remarks. It is against our inclination that we have even introduced so many; as all the requisite effects may be produced by fewer. But it has been the fashion to enumerate so many more in all the works on this subject, that we have felt it necessary to put down more than we approved of, in conformity to the custom.

Compositions for Sky Rockets.

No. 1.—Four ounce size.

Mealed powder - -	1 lb.	4 oz.	0 dwt.
Saltpetre - -	0	4	0
Charcoal - -	0	2	0

No. 2.—Eight ounce.

Mealed powder - -	1	0	0
Saltpetre - - -	0	4	0
Sulphur - - -	0	3	0
Charcoal - - -	0	1	8

No. 3.—One pound, with a sparkling fire.

Mealed powder - -	2	0	0
Saltpetre - - -	0	8	0
Sulphur - - -	0	4	0
Charcoal - - -	0	2	0
Steel filings - - -	0	1	8

No. 4.—Largest sizes.

Saltpetre - - -	4	0	0
Mealed powder - -	1	0	0
Sulphur - - -	1	0	0

No. 5.—Two ounce size, not often used, except in great flights.

Saltpetre - - -	2	0	0
Sulphur - - -	0	8	0
Mealed powder - -	12	0	0
Charcoal - - -	1	8	0

No. 6.—Pound signal rockets, used in the Navy.

Saltpetre - - -	4	0	0
Sulphur - - -	1	0	0
Charcoal - - -	1	8	0

No. 7.—Another ordinary composition.

Saltpetre - - -	4	0	0
Sulphur - - -	1	8	0
Charcoal - - -	1	12	0

No. 8.—Another, for middling sizes.

Saltpetre - - -	8	0	0
Sulphur - - -	3	0	0
Mealed powder - -	3	0	0

These are more than is necessary. Nos. 1, 2, and 6, will answer almost all purposes, and they are equally applicable to line rockets and water rockets, as also to wheels, where force is required.

Miscellaneous Compositions.

Port Fires for Lighting.

Saltpetre - - -	0 lb.	8 oz.	0 dwt.
Sulphur - - -	0	8	0
Mealed powder - -	1	0	0

To be driven very hard.

Red Fires from Mica.

Saltpetre - - -	8	0	0
Sulphur - - -	4	0	0
Mealed powder - -	6	0	0
Mica - - -	3	0	0

Charges for Tourbillons.

No. 1.—A brilliant composition.

Saltpetre - - -	1 lb.	0 oz.	0 dwt.
Sulphur - - -	0	2	8
Mealed powder - -	0	5	0
Pounded iron - -	0	14	8

No. 2.—For four ounce sizes.

Mealed powder - -	2	4	0
Charcoal - - -	0	4	8

No. 3.—For eight ounce sizes.

Mealed powder - -	2	0	0
Charcoal - - -	0	4	8

No. 4.—Larger sizes; brilliant fire.

Mealed powder - -	2	0	0
Saltpetre - - -	1	0	0
Sulphur - - -	0	8	0
Pounded iron - -	0	0	8

The principles for the composition of tourbillons is the same as for sky-rockets. As they become larger, that must be made weaker. The sky-rocket compositions answer for them very well.

Various Compositions for Small Wheels.

These are marked merely as they are quick or slow, that the artist may be enabled to vary the effects accordingly.

No. 1.—Slow, without sparks.

Saltpetre - - -	2 lb.	8 oz.	4 dwt.
Sulphur - - -	1	6	0
Mealed powder - -	5	0	0

No. 2.—Quick, with sparks.

Saltpetre - - -	3	8	0
Sulphur - - -	1	2	0
Mealed powder - -	1	0	0
Charcoal - - -	1	0	0

No. 3.—Quick, without sparks.

Saltpetre - - -	0	8	0
Sulphur - - -	0	4	0
Mealed powder - -	0	8	0

No. 4.—Quick, with brilliant sparks.

Saltpetre - -	0	3	0
Sulphur - - -	0	1	0
Mealed powder - -	0	12	0
Steel filings - - -	0	3	0

No. 5.—Quicker than 3, without sparks.

Saltpetre - - -	1	4	0
Sulphur - - -	1	8	0
Mealed powder - -	4	0	0

No. 6.—Quick, with bright sparks, and for the single Chinese wheels.

Saltpetre - - -	0	0	8
Mealed powder - -	0	4	0
Pounded iron - -	0	1	8

No. 7.—A slow composition.

Saltpetre - - -	4	0	0
Sulphur - - -	2	0	0
Mealed powder - -	1	8	0

No. 8.—This is a brilliant one of considerable strength, and answers for all general purposes.

Saltpetre - - -	0	8	0
Sulphur - - -	0	3	0
Mealed powder - -	3	0	0
Steel filings - -	0	3	0

We shall add no more, as the different effects of even these are scarcely distinguishable by the eye, although this is not one quarter part of the number commonly recommended in the treatises of pyrotechny.

Pyrotechny.

Compositions for Pin Wheels.

No. 1.—A composition without sparks, and strong.

Saltpetre - - - -	1 lb.	4 oz.	0 dwt.
Sulphur - - -	1	8	0
Mealed powder - -	4	0	0

No. 2.—Sparkling.

Saltpetre - -	2	0	0
Mealed powder -	8	0	0
Sulphur - - -	1	0	0
Steel filings - -	0	4	0

It is not necessary to vary these much, but almost any of the slow or quick compositions above mentioned may also be used in them.

Compositions for Large Wheels.

No. 1.—Brilliant.

Mealed powder - -	2 lb.	0 oz.	0 dwt.
Saltpetre - -	0	4	0
Steel or cast-iron filings -	0	7	0

No. 2.—Brilliant.

Mealed powder - -	2	0	0
Saltpetre - - -	0	12	0
Sulphur - - -	0	4	0
Steel filings - -	0	3	0

No. 3.—Red sparkling.

Mealed powder - -	4	0	0
Saltpetre - -	1	0	0
Sulphur - -	0	8	0
Charcoal - -	0	4	8

No. 4.—Brilliant and strong.

Mealed powder - -	1	0	0
Saltpetre - -	0	2	0
Steel filings - - -	0	3	8

No. 5.—Brilliant and stronger.

Mealed powder - -	2	0	0
Pounded iron - -	0	5	0

No. 6.—Not strong, nor brilliant.

Saltpetre - - -	2	0	0
Sulphur - -	0	12	0
Charcoal - -	0	8	0

Brilliant Fires with Charcoal alone.

No. 1.

Mealed powder - -	16	0	0
Charcoal, coarsely powdered -	3	0	0

This is a very strong composition, producing much sparkling fire.

No. 2.

Saltpetre - - -	0	2	0
Mealed powder - -	0	14	0
Charcoal - - -	0	4	0

A composition of less strength.

No. 3.

Saltpetre - - -	0	4	0
Mealed powder - -	1	0	0
Charcoal - -	0	6	0

This composition answers for Roman candles.

No. 4.

Saltpetre	3 lb.	8 oz.	0 dwt.
Sulphur	1	2	0
Mealed powder	1	0	0
Charcoal	1	0	0

A composition used for wheels.

The effects of all these are alike, and they merely differ in strength. · But it would simplify the business much, to take only one of these, such as No. 1. and to make it stronger or weaker as may be required, by altering the proportions of the charcoal.

Brilliant Fires with Charcoal and Iron, or with Iron alone.

No. 1.

Mealed powder	1 lb.	0 oz.	0 dwt.
Steel filings	0	3	0
Charcoal	0	0	8

A composition of moderate strength, used for wheels or fixed cases.

No. 2.

Saltpetre	10	0	0
Sulphur	2	8	0
Charcoal	1	4	0
Cast iron pounded	7	4	0

A composition used for cascades of fire.

No. 3.

Saltpetre	1	5	0
Sulphur	0	3	0
Mealed powder	9	0	0
Steel filings	1	6	0

A variety of the same commonly used for brilliant suns or other fixed fires.

No. 4.

Saltpetre	0	6	0
Sulphur	0	2	0
Mealed powder	2	0	0
Steel filings	0	6	0

Used for the fixed cases called flower pots.

No. 5.

Saltpetre	4	0	0
Sulphur	2	0	0
Mealed powder	8	0	0
Charcoal	3	0	0

Strong, and used for gerbes.

No. 6.

Mealed powder	1	8	0
Coarse pounded iron	0	8½	0

Very brilliant strong fire, used for gerbes.

No. 7.

Mealed powder	1	0	0
Charcoal	0	1	0
Steel filings	0	0	4

A strong brilliant composition, used for serpents, in sky-rockets, or fixed cases.

No. 8.

Mealed powder	3	0	0
Pounded iron	1	0	0

A strong brilliant fire for any purpose, and chiefly for gerbes.

It is unnecessary to enumerate more of these sparkling compositions, as indeed one-half of these are more than sufficient for use. It depends on the taste and judgment of the artist to select those which on trial may please him best. It is always necessary, at any rate, to try the effect of a fire before using it; and if it is not liked, it may be modified at discretion. We should also recommend in this case, as in the former, to choose one or two compositions, such as Nos. 1, 2, 3, and merely alter their strength by different proportions of mealed powder.

Slow Compositions, or Compositions that do not sparkle, for varying the Effects in Wheels or Fixed Cases.

No. 1.—White.

Saltpetre	8 lb.	1 oz.	0 dwt.
Sulphur	4	0	0
Mealed powder	2	2	0
Zinc filings	3	0	0

No. 2.—Blue.

Saltpetre	4	0	0
Sulphur.	2	0	0
Mealed powder	2	0	0
Antimony	2	0	0

No. 3.—Whitish.

Saltpetre	4	0	0
Sulphur	2	0	0
Mealed powder	1	8	0

No. 4.—Blue. Slower than No. 2.

Saltpetre	4	0	0
Sulphur	1	0	0
Antimony	1	6	0

No. 5.—Very slow whitish blue.

Saltpetre	1	4	0
Sulphur	0	4	0
Antimony	0	0	2

We shall forbear to insert any more, as these are sufficient for all useful purposes.

Stars for Sky-rockets or other purposes.

No. 1.

Saltpetre	1 lb.	0 oz.	0 dwt.
Sulphur	2	0	0
Mealed powder	3	0	0
Charcoal	0	12	0

These throw out sparks when burnt.

No. 2.—Blue.

Saltpetre	4	0	0
Sulphur	2	0	0
Mealed powder	0	8	0
Antimony	0	4	0

No. 3.—Ditto.

Saltpetre	1	0	0
Sulphur	0	4	0
Antimony	0	5	0

No. 4.—White.

Saltpetre	1	0	0
Sulphur	0	4	0
Mealed powder	0	2	0
Zinc filings	0	3	0

All these require to be mixed with gum water. We have suppressed the numerous other receipts in the books, as they produce no effects different from the above.

Large Lights for Effect, or for varying other Fireworks.

No. 1.—Whitish.

Saltpetre	6 lb.	0 oz.	0 dwt.
Sulphur	1	8	0
Red orpiment	0	8	0

No. 2.—White.

Saltpetre	8	0	0
Sulphur	3	8	0
Zinc filings	2	0	0

No. 3.—Blue.

Saltpetre	10	0	0
Sulphur	4	0	0
Antimony	3	0	0

Speckies or Lights used for Illuminations.

Red Fire used at the Theatres.

Take 40 parts of dry nitrate of strontian, 13 parts of finely powdered sulphur, 5 parts of oxymuriate of potash, and 4 parts of sulphuret of antimony. The oxymuriate of potash, and the sulphuret of antimony, are first to be powdered separately in a mortar, and then mixed together on paper; after which they may be added to the other ingredients which have been also previously powdered and mixed. It is not necessary to make the mixture more accurate than it can be rendered by rubbing the whole together on paper. Some operators add a little realgar, or red orpiment, to the mixture. If on trial this fire should not burn bright, a small quantity of fine charcoal or lamp-black may be added.

Purple Speckies.

Mealed Powder - - - -	2 oz.
Sulphur - - - - -	2
Red Lead - - - -	2
Nitre - - - - - -	6

Bright White Speckies.

Nitre - - - - -	8 oz.
Sulphur - - - - -	4
Zinc Filings - - - -	2

Another White Speckie not so bright.

Saltpetre - - - -	4 lb.
Sulphur - - - - -	2
Mealed Powder - - - -	1

Yellow Speckies.

Saltpetre - - - -	4 lb.	0 oz.
Sulphur - - - - -	2	3
Black Lead - - - -	0	1

These are slow compositions, and are best adapted for the larger illuminations.

Very Blue Speckies.

Saltpetre - - - - -	4 oz.
Sulphur - - - - - - -	2
Regulus of Antimony - - -	1

Very Blue, less bright.

Saltpetre - - - - -	8 oz.
Sulphur - - - - -	3
Common Antimony - - -	2

Green Speckies.

Saltpetre - - - - -	8 oz.
Sulphur - - - - -	4
Nitrate of Copper - - - -	½

These are quicker, and better adapted for small cases.

White Speckies.

Saltpetre - - - -	6 oz.
Mealed Powder - - - -	2
Sulphur - - - - -	3
Zinc filings - - - - -	1

Bright Blue Speckies.

Saltpetre - - - - -	6 oz.
Mealed Powder - - - -	2
Sulphur - - - - -	3
Regulus of Antimony - - -	1

All these compositions require to be very intimately mixed.

Common Blue Speckies.

Saltpetre - - - -	6 oz.
Mealed Powder - - - -	2
Sulphur - - - - -	2
Common Antimony - - -	2

Green Speckies.

Saltpetre - - - -	8 oz.
Sulphur - - - - -	3
Mealed Powder - - -	2
Copper Filings - - -	1

Yellowish-white Speckies.

Saltpetre - - - -	8 oz.
Sulphur - - - -	4
Mealed Powder - - -	1
Red Orpiment - - - -	2

On Military Fireworks.

On military fireworks.

The military branch of pyrotechny is very limited, though, if we were to follow the ancient authors, it might in itself make a volume. We have here selected such parts of it as are now in use, together with some compositions in use still among our neighbours the French and other nations, which we have rejected for some time. We thought it necessary to admit many things throughout this article in both its departments, although we think them absurd, or useless, or superfluous; because readers are accustomed to see them in books of pyrotechny, where they add to the apparent mystery. Had we reduced every thing, as it might easily be, to its simple elements, we should have discarded a good deal of that which we have admitted, and our readers would perhaps have supposed that nothing was told, from being accustomed to see so much.

But in this department, as in the ornamental branch, we have exerted the right of criticism; and in pointing out what we think unnecessary or useless, have enabled our readers to judge for themselves, and select what is most useful. Where there are repetitions, they have arisen from the same compulsion under which we found ourselves, not to deviate too far from the ordinary plans of treatises on this subject.

In the military branch of this art, the chief article, as far as its extent and the number of its details are concerned, is that on iron rockets, or Congreve rockets, as they are called; for which we are indebted however to the French, as our own practice on this branch has not been made public. We cannot, therefore, hold ourselves further responsible for it, and must rely on the accuracy of the French experiments and practice.

Rockets for signals may also be included in the military branch; but it was unnecessary to repeat that here, as those used for this purpose are exactly the same as those which are employed for objects of amusement.

In this department may also be included signal lights of other kinds, of which we have given the receipts, although with some repetition; as the fires used for this purpose are also employed in ornamental works.

But the principal part in this branch, is that which relates to carcasses and other combustible substances, of which we have collected different receipts, with proper directions for compounding and applying them; distinguishing also the useless or antiquated from those which effect the same objects by simpler means. This department might also have been easily simplified; but we thought that even to introduce what we did not approve, was necessary for the gratification of general curiosity.

We cannot, however, too strongly recommend simplicity and cheapness in all these proceedings; and where we have not in every instance thought it necessary to criticise minutely the compositions that we have introduced, our readers will be at no loss in doing it for themselves from the various remarks of that nature, that are scattered throughout this article, and from the general principles that have been laid down.

As no useful arrangement could be made out of the very limited materials of this branch of the subject, we have made no attempt to adopt one, but have placed the different receipts, with the remarks, in the same irregular or accidental manner in which we have found them in the different military treatises which we have consulted. One article, namely, the method of making matches, has been introduced here; although, with respect to the cotton quick and slow match, these are equally or oftener required in the ornamental branch. The reader of the preceding part, will have no difficulty in discovering how and when these things are to be applied.

Composition for setting Fire to Fascine Batteries. (French.)

Mealed Powder	1 lb.	4 oz.
Saltpetre	6	0
Sulphur	1	8

This is inclosed in cases, and thrown among the fascines of redoubts and batteries, or into dry abattis, by hand.

Stink Pot Composition.

Saltpetre	0 lb.	12 oz.
Sulphur	1	8
Quick-Lime	2	0
Mercury	0	1
Common Pitch	4	0
Rosin	2	0
Oak Saw-dust	0	6
Pigeon's Dung	1	0

This is an ancient composition, and is now out of use. It is superseded by the simple one with nitre and sulphur.

Quick-Match.

Cotton	1 lb.	12 oz.
Saltpetre	1	8
Mealed Powder	10	0
Spirits of Wine	2 quarts.	
Water	3 do.	

This is the method commonly used; but the reader is desired to consult the following directions.

Fuse.

Saltpetre	6 lb.	8 oz.
Sulphur	2	0
Mealed Powder	5	8

Portfire.

Saltpetre	6 lb.	0 oz.
Sulphur	2	0
Mealed Powder	1	0

This is also the common signal white light.

Laboratory Blue Lights.

Saltpetre	7 lb.	0 oz.
Sulphur	1	12
Red Orpiment	0	8

Used for signals also.

Smoke Balls.

Corn Powder, bruised	5 lb.	0 oz.
Saltpetre, pulverized	1	0
Sea Coal	1	8
Pitch	2	0
Tallow	0	8

Smoke Balls. (French.)

Mealed Powder	10 lb.	0 oz.
Nitre	2	0
Pitch	4	0
Common Coal	3	0
Tallow	1	0

This is also used for annoying an enemy, chiefly at sea, by throwing it into the port holes, like the former. It may be used in iron or tin cases; but it is not so effectual as the former. Indeed it is more for show than use, as its smoke does not annoy the men as the sulphureous gas generated from the preceding composition does.

Hand Lights.

Saltpetre, pulverized	6 lb.	0 oz.
Sulphur	3	0
Mealed Powder	1	4

Used also for rocket heads.

A Carcase Composition.

Saltpetre, pulverized	6 lb.	4 oz.	0 dwt.
Ground Sulphur	2	8	0
Rosin	1	14	0
Linseed Oil	0	7	8

Fire Hoops.

Saltpetre	3 lb.	0 oz.
Sulphur	1	0
Antimony	0	12
Linseed Oil	0	8

These are intended to throw among men when storming a redoubt or work.

Fire Balls.

Saltpetre	1 lb.	0 oz.
Sulphur	0	4
Mealed Powder	0	8
Camphor	0	8
Bees-wax	0	4

This is the old English composition, and is superseded by the better fire from zinc.

Bengal Lights.

Saltpetre	2 oz.	0 dwt.
Sulphur	0	9
Yellow Orpiment	2	4

A very good signal light.

Round and Oblong Carcases, and Fire Barrel Composition.

Saltpetre	5 lb.	0 oz.
Sulphur	2	0
Antimony	0	8
Rosin	1	0
Tallow	0	8

Burning Fascines. (French.)

No. 1.

Pitch	24 lb.
Tallow	12
Oil of turpentine	6

No. 2.

Pitch	4
Rosin	8
Turpentine	4
Sulphur	32
Nitre	16

No. 3.

Black pitch	8
Burgundy do.	4
Wax	12
Turpentine	2
Sulphur	4

No. 4.

Black pitch	6
White pitch	6
Rosin	4
Tallow	8
Sulphur	3
Oil	16
Nitre	3
Tartar	3

Other compositions are added, containing camphor and many useless or absurd substances, which we omit. These are specimens of the ancient superfluous and unmeaning mixtures. No. 2. is the best for a quick fire; but the rosin, turpentine, and pitch, may all be replaced by pitch alone. No. 1. burns badly for want of nitre, but will answer in large masses with a free ventilation. It may be extinguished, however, which with regard to No. 2. is not easy. Nos. 3. and 4. are extremely silly contrivances. But our old books are, like their modern ones, full of the same absurd contrivances. Let it always be remembered, that simplicity and cheapness are essential points in all these compositions, and that nothing can well be trusted for burning effectually which does not contain nitre.

Light Balls. For discovering the Enemy's works.

Rosin	9 lb.
Pitch	6
Wax	6
Tallow	1

This is a bad composition, and will neither burn well nor give light. In a case, it cannot burn at all, for want of air.

Do. A French Light Ball.

Rosin	5 lb.	8 oz.
Sulphur	3	0
Alum	1	8
Starch	0	8
Nitre	4	6
Powder	8	0
Linseed oil	0	4
Oil of spike	1	0

This is an extremely absurd composition. The alum and starch are noxious, and the oil of spike is a superfluous expence. Cleared from these, it is not a very bad composition, but is far too violent for a light ball.

Another Light Ball.

Nitre	40 lb.
Sulphur	15
Antimony	3
Pitch	3

This is a very good composition; but zinc filings, in the same proportion as the antimony, produce a far brighter light. This will burn in paper shells, and is conveniently used from an eight inch mortar. It should have three holes of an inch and half diameter, and be made strong enough to bear the explosion. It must also be carefully primed.

Suffocating Pots; commonly called Stink Pots.

Sulphur	6 lb.
Nitre	5

This is the most effectual and annoying of all these contrivances. It is rammed into large wooden cases, well primed and thrown by hand. It is used to throw into the port-holes, on boarding, where it effectually clears the decks.

Large Carcase Composition.

Nitre	6 lb.	4 oz.
Sulphur	2	8
Rosin	1	14
Antimony	0	10
Tallow	0	10
Turpentine	0	10

The nitre and sulphur are to be finely powdered and melted together, with the other ingredients, in an oil bath, to prevent any hazard of combustion. It is poured into the carcases while warm.

Carcase Composition. (French.)

Sulphur	10 lb.	0 oz.
Nitre	4	0
Mealed powder	4	0
Corned powder	3	0
Antimony	3	0
Oil of turpentine	0	12

Another Composition.

Nitre	4 lb.	0 oz.
Mealed powder	2	0
Borax	1	0
Camphor	2	0
Sulphur	1	0

These are bad compositions. In the last the camphor is expensive, and the borax useless.

Valenciennes Composition, for Shell Carcases, used at the Siege.

Nitre	50 lb.	0 oz.
Sulphur	28	0
Antimony	18	0
Rosin or pitch	6	0

This composition is melted into cylinders, equal in diameter to the holes of the shell, and introduced into it with the bursting charge of powder. It is very tenacious, and is therefore scattered about among the works when the shell bursts.

Cotton Slow-Match for Fire-Conductors.

Cotton Slow-match for fire-conductors.

The same cotton that is used for candles is dipped into a weak solution of pure nitre and dried. If the coal falls off on burning, so that the match goes out, there is too much nitre. It may be brushed out of the cotton by the hand in this case; or else the strength of the solution must be reduced.

This match is used when it is required to gain time in setting fire to an ornamental firework. It is indispensible in the Chinese drum; the action of which depends entirely upon it. It requires to be timed, by trial, before using; that it may be known how long a given length will burn. It is only in this way that accuracy in the succession, or simultaneous burning of the parts of a complicated piece of firework can be insured.

Cotton Quick-Match for Fire-Conductors.

Cotton quick-match for fire-conductors.

The same cotton is used for this purpose. The composition is only gunpowder, which is commonly tempered into a paste with spirit of wine or vinegar, to prevent the separation of the nitre by crystallization on drying. This paste is well worked in among the cotton, which should be thus rendered quite stiff. Care must be taken to keep it from breaking when dry, as the composition falls off and the burning is retarded. It is essential that it should communicate instantaneously, as well for military priming as for ornamental fireworks. In these, it is the only conductor used for pieces that are to fire in succession; and it is then inclosed in sufficient tubes of strong cartridge paper. These, like the fireworks themselves, must be painted whenever they are to be used in the open air, to prevent all risk of moisture, which would impede their regular action.

Composition for Tubes.

No. 1.

Mealed powder - -	12 lb.
Saltpetre - -	4
Sulphur - - -	2
Charcoal - -	3

Stronger Composition.

No. 2.

Mealed powder - -	16 lb.
Saltpetre - - -	4

These are put into tin tubes, furnished with a cup and quick match, for the purpose of being introduced into the vents of guns instead of priming.

Composition for Fuses, for Shells, and Carcases.

No. 1.—Large size.

Mealed powder - -	5 lb.
Nitre - - -	3
Sulphur - - -	2

No. 2.—Stronger.

Mealed powder - -	7
Nitre - - -	4
Sulphur - -	2

No. 3.—Stronger.

Mealed powder - -	10
Nitre - -	6
Sulphur - - -	3

No. 4.—Stronger.

Mealed powder - -	5
Nitre - -	3
Sulphur - -	1

For Eight Inch Shells and Grenades.

No. 1.

Mealed powder - -	4 lb.
Nitre - - -	3
Sulphur - - -	2

No. 2.

Mealed powder - -	5
Nitre - - - -	3
Sulphur - - -	2

No. 3.

Mealed powder - -	10
Nitre - - -	6
Sulphur - - -	3

These are driven into turned wooden tubes of beech, in the most regular manner, and with the greatest force possible. The tube has a cup for priming and quick match, is closed at the opposite end, and is six inches long. An inch, or any given length, must burn a definite time, or else the fuse is rejected. The time of bursting of the shell is calculated on this, and on the time of flight. The tube is cut off to the calculated length at the moment when it is required.

Fire Arrows.

No. 1.—Burns ten minutes.

Mealed powder - -	10 lb.
Nitre - - -	12
Sulphur - - -	6

No. 2.—Burns seven minutes.

Mealed powder - -	4
Nitre - - -	16
Sulphur - - -	8

No. 3.—Burns six minutes.

Mealed powder - -	8
Nitre - - - -	16
Sulphur - - - -	6

No. 4.—Burns five minutes.

Mealed powder - - -	8 lb.
Nitre - - -	16
Sulphur - - -	4

No. 5.—Modern composition.

Mealed powder - -	6
Nitre - -	16
Sulphur - - -	7

These are tempered with linseed oil, and attached to the arrow.

Tow-match for the Linstocks.

Combings of flax are twisted into a loose rope, and boiled in a weak solution of carbonate of potash, or common lye of ashes.

The same:—A better Composition.

The tow or flax-rope is boiled in a solution of sugar of lead, in the proportion of six drachms to a pint of water, for a few minutes, and dried. A convenient match is also made by rolling the blue paper used for sugar-loaves, into cylinders resembling candles, and soaking them in the same solution.

Third Composition. Old Slow Match.

The tow-rope is boiled for some hours in a mixture of lye and quicklime.

Of Iron Rockets.

These rockets, known by the name of Congreve rockets, have become greatly celebrated, from their having been used on various occasions in our late war. The first use of them, we believe, was at the bombardment of Copenhagen, where they were said to have set fire to many houses. After this they were used against the Boulogne flotilla, and against Flushing. Not to enumerate the multitude of instances where they have been applied to various kinds of service, we shall only further remark, that they were used with great success against cavalry at the first battles of Leipsic, by the Anglo-Russian troops, and at the affair of Bayonne.

For military purposes, they are used in different modes. If they are intended against towns, or works, they are furnished either with a shell or a carcase, according to circumstances. In the latter case, however, a separate carcase is not used; but the composition is placed immediately in the conical iron cap, which is furnished with holes, to permit the flame to pass out. In this way a rocket of moderate dimensions is enabled to carry a considerable quantity of combustible matter, and in a very convenient form. Such carcase rockets are particularly useful against shipping, as they may be fired from small boats, and thus brought into shoal water, or over bar harbours, where large mortar vessels could not be used. Thus also they may be used in the night, or in calms; as small boats can approach a vessel at anchor, or otherwise, under those circumstances where a larger class of shipping would be useless. But we need not point out the numerous cases in military service, where rockets of this nature may be advantageously adopted, when mortars for throwing carcases or shells would be unattainable or incapable of being used.

Their use in the field is of a different nature, and they may be applied either for the purpose of injuring the enemy directly, or for that of disordering his cavalry by exciting alarm. In the former case they are thrown, in the same manner as against works, at a high angle for a long range, and are also employed in this way to carry a shell; thus producing the effects of howitzers. They have, however, been found principally of use in the latter case; and for this purpose the size is of less moment, provided the range is sufficiently great. To produce the best effects in this way, they are placed on the ground, and fired at very low angles, which may be varied according to the intended range. In this manner, after they first strike the ground, they rebound again, like a ricochet shot; and as this may happen many times in the case of the rocket, just as it does in that of the shot, the alarm thus excited among horses is so great, as to break or disturb the order of the squadrons. This effect is further increased by the uncertain directions which they take after each rebound, from the manner in which they strike; so that it serves no purpose for the lines to open a way for them, as they may fly sidewise, or even return backwards among the horses.

As we must not here enter further on these questions of military operations, we shall now add that the same rockets have lately been used in the whale fishery, instead of the harpoon. When fired successfully, they not only penetrate deeply into the fish, but by burning and exploding within him, he is immediately killed, so as after a short plunge, or sometimes without any, to float on the surface of the water. Thus all the labour, expence, and risk of running out lines is avoided, while the prey is secured without the possibility of escape.

As the sizes and weights of iron rockets are often considerable, the latter reaching from sixteen even to forty-two pounds, a particular apparatus, or frame, is required for firing them. It is also necessary that proper carts should be provided for carrying them in the field; and as it further requires practice and experience in the men to make use of them effectually, and to avoid hazard, a regular rocket establishment, both of men and carriages, has been introduced into our military service by Sir William Congreve, to whom we are indebted, not only for the original proposition, but for every thing that has been done in this department, whether with regard to the mechanical and pyrotechnic part, or the military arrangements. As it is not here our business to enter into these, we shall proceed to describe the construction of the rockets themselves, from the French publications, in as far as that is already before the public. In our own country, these are circumstances which it has, for very good reasons, been thought proper to reserve from the general curiosity.

Construction of Iron Rockets.

The principle of the iron rocket is the same as that of an ordinary signal or ornamental one. But, on account of the greater diameter, it is necessary to use cases made of iron instead of paper. Many advantages flow from this change. By diminishing the diameter, the resistance of the air is also diminished, and thus the length of the range, which is a very important circumstance in war, is also increased. The bulk, and consequent stowage, is thus also diminished, which is in itself a valuable consideration. In a similar manner, the strength of the cases is greater, so that they are better able to bear the driving. But the principal advantage is that without which they would, in many cases, not answer their purposes at all, namely weight sufficient to allow them to penetrate; whether into houses or magazines, or into the bodies of men or animals. The sharp conical iron head is, in fact, an essential part of the weapon; and this could not be used at all, unless the whole case was made of the same material. On comparison, the difference of expence between cases of paper and of iron will not be found so great as it appears at first sight.

The case is a cylinder of sheet iron, as soft in quality as can be procured. It is dovetailed in the longitudinal joint, where it is also brazed; and, for a diameter of three inches, the iron need not be more than one-fifteenth of an inch in thickness, increasing or diminishing as may be necessary, for the larger and smaller sizes. The inside of this case is lined with a single fold of cartridge paper pasted on. At the vent end, a cup is brazed on, which may be made either of iron or copper, and through this the vent or choke-hole, properly calculated for the diameter of the case, is made. The cap is an iron cone, also of plate iron, which is fixed on after the rocket is driven, and which either carries a charge of powder, or a burning composition like that used for carcases; in this case the cap is perforated with two or three holes, and is then surrounded by painted canvass.

In making these cases, a very different apparatus is required from that used for paper-rockets. A block, or more, of tough oak or elm, must be provided, in which semicylinders are cut, of such sizes as to take in each diameter of rocket that is to be made. An iron solid cylinder, or rather a number of these, of diameters adapted to each scale of rocket, is the next tool required for making up the cases. Besides these there are required all the tools of a brazier and worker in sheet-iron, such as scissars, hammers, anvils, files, vices, drills, &c.

The requisite dimensions of the rectangle which will cover the iron cylinder being measured, with an additional allowance on the largest side for dovetailing, it is to be folded over the mandril or centre, so as to overlap at the joint, and then wrought with the hammers on the grooved block till it fits as close as possible in every part except the intended joint. Having done this, the dovetails are then to be cut out by means of the cold chisel and file, and then the whole is to be put together, and closely fitted all round the mandril. When this is done, it is to be well wrought with the hammer, till the mandril will slip in and out with equal ease in all parts. Four rings, or hoops of iron, must then be driven on the case, thus far finished, to prevent it from starting, besides which an iron wire may be wound round it. It is then ready for brazing, and must be carefully brazed along the whole joint in the usual way.

After this it must again be put upon the mandril, and dressed in the block till the former slips easily in and out, and till the surface is uniformly smooth and even. If any holes or defects are now discovered in the brazing, they must be repaired. The cup for the vent-hole, which has previously been hollowed to the proper shape for fitting upon the nipple of the mould, must now be bored to the proper dimensions; taking care that it lies equally round the axis of the rocket. For this purpose it must be perfectly centred in a lathe.

The case must next be lined with cartridge paper. For this purpose the mandril is first soaped, and the paper is rolled and pasted over very slightly, so as just to hold upon it. The outside is then covered with

used on water, by means of proper floats. It only remains, therefore, to add a few words respecting those transparent figures for the water, which are recommended in the books of pyrotechny.

In this manner it has been attempted to represent water fowl, ships, and other more complicated figures; such as chariots with tritons and dolphins, and similar heathen devices. Such figures as this are, however, rather the business of the artist who constructs machinery for the theatres; and we shall, therefore, forbear to give any directions concerning them. They do not admit of much fire; and, generally speaking, their effects are very poor, when compared with the trouble and expence with which they are attended. An artist will, at any rate, find no difficulty in arranging in them such fireworks as they are capable of bearing: and it must also be left to his own judgment to place the communications in such a manner as shall best insure their proper performance.

In terminating this part of the subject, although somewhat out of place, we shall also point out the facility with which a paper kite may be converted into a firework, by disposing lights upon it, and setting these on fire when it is in the air, by means of a line rocket on its string. But a strong breeze of wind is necessary for this purpose, while it is also only applicable to objects of private amusement.

The Chinese Drum.

The Chinese drum. PLATE CCCCLXXV. Fig. 31.

This very entertaining and delicate firework is peculiar to the Chinese, and is described in terms of no small admiration, and of something like wonder, in Sir George Staunton's narrative. No account of its construction has yet been published, and as we have both dissected and imitated it, we are able to gratify the curiosity both of our readers and of the pyrotechnists. It will be necessary to consult the plate on this subject, as the description could not be rendered intelligible without that assistance.

In its external appearance, this machine resembles a drum, or a cylindrical bandbox, and is generally ornamented with paintings of various kinds, so as to give it a pleasing appearance. When it is to be fired, it is suspended from a proper stand, at a height of 12 or 15 feet, by means of a loop at the top, and is fired by means of a match at the lower end. Immediately there drops out below a transparent piece, accompanied by a firework of some kind, which, after it is burnt out, falls to the ground, and is succeeded by another object, but of a different nature, and so on in succession, until the whole is expended. The number or succession of these mutations may be unlimited, as it is quite as easy to insure the proper burning of a hundred as of two; but it is generally confined to ten or twelve.

These objects consist of castles, ships, lanterns, or other devices, which vary according to the fancy of the artist, and which we must leave, in a great measure, to the discretion of our own pyrotechnists, as we can only describe enough of them to convey an idea of the general principle. The effects are easily apprehended. If it be a lantern, for example, that first comes down, it is painted in transparency, with figures of men or animals, or with fruit or flowers, or with architectural patterns, or with any other objects according to the fancy of the operator. The colouring may also be varied; so that if there are two or more lanterns employed in one drum, they may be as different from each other as possible. They may in the same way vary in shape, so as to represent cylinders, or globes, or cones, or pyramids, or other figures, so as to produce an infinite variety. At the moment that such a lantern, if that be the object, falls down, it is illuminated within by means of a speckie, or illumination light; and as the colours of these may be varied, so the appearances of the firework are. There may further be two lights of different colours, the one to succeed the other, so that the varieties, of which the lantern alone is susceptible, are very great, even in its simplest form.

But it may also be further modified, by introducing fires of different kinds round its lower margin, such as small gerbes, or spur lights, or crackers, or serpents, or wheels. These are managed further in various ways, so as to fire in different successions; all of these being regulated by the general methods which we shall presently describe. In these several ways then, and by variously combining them, the number of appearances that the lantern may display is such, as, in the hands of an ingenious artist, to produce as much variety as can be desired.

Supposing now that this first figure, consisting thus of a lantern, is expended, as soon as it falls to the ground, perhaps two ships descend from the drum. These may also be varied in many ways, as to their forms and colours, and they are so managed as to engage each other. These also are made of transparent painted paper, properly supported, like the lantern, by a wooden framework. The guns consist of small crackers, disposed on the gunwales; and they may be further varied by carrying lights in the tops, or wheels at their sides or sterns, or by discharges of sky-rockets, which, for this purpose, are made no larger than the smallest goose quill. The form and the smoke of our own steam-boats might very appropriately be introduced in this manner. Single ships are also made use of, and then they are decorated with flags, illuminated with lights, and provided with rockets, wheels, crackers, and other emblems of rejoicing.

The next mutation may be a castle, and this also admits of much variety. It may be painted and lighted in various ways, and further provided with any of the different fireworks already mentioned. Or two castles may be made to engage each other, or else a ship may engage with a castle; all of these being conducted exactly on the same principles, and varied according to the taste and ingenuity of the artist. An illuminated pagoda offers another mode of mutation, as do houses, temples, and various objects which we need not enumerate. Animals may also be introduced. Thus, dragons or griffins may be caused to engage each other with fire, as may enchanters and fiery chariots; but we need not describe more of the figures and mutations that may be introduced into this very amusing firework. We will, therefore, proceed to describe the construction, as far as it can be rendered intelligible without actually examining the machine itself.

To make the case or including cylinder, as many hoops of ash or cane are required as there are mutations intended, and one more. The diameter of these depends on the intended size of the firework. It cannot conveniently be less than a foot and a half, and does not commonly exceed three. As it is difficult for an unpractised hand to succeed in making this machine on a small scale, it will be found convenient to adopt the larger sizes.

Supposing now that six mutations are required, the total length of the case or drum must be three feet, or somewhat more, if the diameter exceeds two feet. An

inexpert artist will find it convenient to take plenty of room in this direction, to enable him the easier to pack away his mutations; an expert Chinese will place in a depth of three inches what an English workman could not crowd into six. Seven hoops will be required for six mutations, that there may be six intervals, and they are then to be framed into a cylinder, by means of three flat uprights of similar light materials. A cross of the same description is to be made on the top of the cylinder for supporting the mutations, and for fixing the loop by which the drum is to hang when fired. Six inches or eight, if this firework is of a large size, will thus be left between each of the hoops. The whole of this frame-work may be fastened by means of string covered with a little glue. The case is then ready to receive its charge, as it cannot be covered with paper till that is arranged, and all the primings and conductors fixed. But as we need not recur to the case again, we shall here finish its description by saying, that when the whole of the mutations have been introduced and arranged, it is to be covered with stout cartridge paper, sufficiently strong to prevent accidents, all over, which may then be further covered with white paper and painted; or otherwise ornamented in any other manner that the artist may think proper.

The mode of making the mutations or transparent pieces is as follows: and we will first take the simplest case, that of a square lantern. Two squares of light wood, but strong, are framed for the top and bottom, in a firm manner, with glue; and these, particularly the bottom one, must have substance enough to bear the pins for supporting wheels. They are connected at the corners by strings, of the requisite length, so as to form a skeleton, and there is further a diagonal piece of wood, or a cross, as may be preferred, to be placed in the top and bottom; the upper one to support the connecting string by which the lantern hangs, and the lower to carry the illumination lights. The lantern is not to be finished till all the fireworks are settled and fixed ready for firing, in the manner we shall presently describe; after which it is to be covered with transparent paper, painted with dark colours, or with white paper, painted in transparent colours, such as those used for window blinds. This covering must be so thin as to allow the lantern to be pressed up, at least as close as the space which it is to occupy in the drum.

Towers, castles, ships, pagodas, &c. are all made on the same principles; and as we could not detail their construction to any useful purpose, they must be left to the ingenuity of the artist. It is only necessary to remember, that the transverse framing must always be sufficiently strong to carry the pins for wheels, or to support rockets, crackers, serpents outside, and lights within; and that the sides must be made of strings, to allow them to be packed up within the body of the case. The wooden part of a ship may be the gunwale and the keel; or if these are made narrow, they may be fully framed with their masts, and the necessary rigging, and laid on their sides in the case. The same practice may be adopted for dragons and such like objects; and, when necessary, a little more room may be allowed between the hoops for this class of transparencies. We need say nothing more on the method of painting and ornamenting all these figures or mutations. The general principle is the same in all; to use brilliant and transparent colouring, while in all other points the artist is free to follow his own taste. It is now necessary to describe the fireworks, and the method of attaching and disposing them about the transparencies.

Chinese drum.

All those figures that are large enough to contain one in their cavity, without risk of taking fire, are to be provided with an internal illumination light or speckie, which is to be properly fixed on the middle of the bottom frame. Ships, and such like objects, do not admit of this ornament. These fires are made according to the compositions described in another part of this article, and which we need not therefore repeat; and they may be varied by using different coloured lights, either in the same piece in succession, or in the different pieces. Before these are fixed in their places, they must be primed and furnished with a bit of quick match, and they are then ready to be introduced into the line of the communicating fire.

The wheels used for this purpose cannot well be made in the spiral form, as these occupy too much room. They are single case wheels, perforated in the middle, and bored with two lateral opposed holes at the extremities; but as the method of making these has also been described elsewhere, we need not repeat it. These wheels may be introduced in various ways, according to the taste of the artist; and, for example, if the object be a lantern, one may be fixed on each side of the bottom frame. The pin which carries them is firmly fastened into that part, and then they are laid parallel to it, and secured by two slips of very slight paper. These also must be properly primed with quick match, well secured, before any thing further is done.

Rows of crackers, made in the manner of the Chinese crackers elsewhere described, are fixed, by means of a bit of string or pasted paper, wherever they may be required. If in a ship, they are disposed round the gunwale; if in a castle, in the loop-holes, or on the battlements, and so on. Where dragons are to be used, a large cracker may be inclosed within the body, which is to be fired last of all. Serpents may be disposed in similar ways, but their heads must always be so directed that they may fly downwards, or out of the case, as they might otherwise get entangled in it above, and fire some of the movements before their time. This is an accident cautiously to be avoided throughout the whole construction of the machine, as it would entirely ruin the performance and spoil the effect. All these, like the former, must be primed before they are first fixed, as this is not so easily done afterwards.

The only other fires that can be introduced, are small gerbes, or spur lights; and these, like the others, may be fixed in any convenient places; always taking care that their fire be directed outwards, for the reason last mentioned. Sky-rockets, not exceeding an inch in length, may be fixed in some of the movements. Their sticks are made of a slender piece of slit bamboo; but they must be so disposed outward when the mutation piece falls, that they may fly off clear of the drum. An ingenious artist will easily find the means of managing this without any particular directions.

Supposing now all the pieces to be framed and provided with their several fires ready primed, a stout string is to be hung up to the ceiling of the artificer's room. From the top downwards a mark is made, as long as the drum, and about a foot or a foot and a half, or even two feet or more, according as the operator may wish the piece to descend more or less below it when it is lighted. The last or uppermost

PLATE CCCCLXXVI. Fig. 3.

gether, is two inches and two-tenths, the brass limb being an inch and two-tenths more remote from the centre than the iron one. In order to reduce the limb to a true plane, the quadrant *a b d o*, Fig. 3. was placed firmly on a level plane with its brass limb upwards. To a vertical axis *l m*, pointing to the centre *o*, was fixed an iron arm *m n*, carrying an iron scraper *p*, which, when turned round the axis *l m*, scraped the brass to a perfect plane, the edge of the scraper being correctly perpendicular to the axis of motion.

Two arches were struck upon a brass limb, one with a radius of 96.85 inches, and the other with a radius of 95.8 inches.

The outward arch is divided into ninety-six equal parts each, which are again divided into sixteen equal parts, and the inner arch is divided into degrees and twelfth parts of a degree.*

The beam of the compass, by which these arches were struck, was prevented from bending by several braces, and when an arch was struck, 60 degrees of it was determined by placing one point of the compass at *a*, and making a stroke with the other at *b*. The arch *a b* was then bisected in *c*, by drawing two small arches upon *a* and *b* as centres, and with such a radius, as to cross the arch *a c b* in two points, as near together as possible without touching. The small interval between these points was then bisected at *c* by the estimation of the eye, aided by a magnifier. After this, the intervals *a c* or *c b* was taken with the beam compass, and transferred from *b* to *d*, which determined the length of the quadrantal arch *a d*. Each of the three arches being bisected in the same manner, the quadrant was divided into six equal parts, containing fifteen degrees each, and every one of these was divided into three equal parts, in the following manner. To avoid making any superfluous points in the quadrantal arch, with its radius unaltered, but upon any other centre there was struck a faint arch, upon which the chord of fifteen degrees, already found, was transferred from the quadrantal arch, and the third part of fifteen degrees being determined by trials on the faint arch, was transferred back again upon the quadrantal arch, which was thus divided into eighteen equal parts, containing five degrees each, and the fifth part of these was found by trials as before, in dividing a separate arch, drawn upon a new centre, for this purpose only, the subdivisions of the degrees into twelve equal parts were made by bisections and trisections as before, so that the whole quadrant was thus divided without using any superfluous point.

The outward arch of the quadrant was divided by bisections into ninety-six equal parts, till sixty degrees or two-thirds of the quadrant became divided into sixty-four, and the other third into thirty-two equal parts, making in the whole ninety-six. Every one of these was likewise divided into sixteen equal parts by continued bisections. These two sorts of divisions form a check upon each other, 'being in reality two different quadrants; and the divisions of the one being reduced to those of the other by a table. (See ASTRONOMY, Vol. II. p. 724.) They never differed above five or six seconds in any part of the limb, the preference being always given to the bisected divisions, as having been determined by a simple operation.

As the divisions now made were only fine points on the arch *a d*, it was necessary to draw lines through each of them. But as it was both difficult and tedious to draw lines exactly through every point by the edge of a ruler, the following method was adopted:—In order to divide any other concentric arch *f h t* by cross strokes into parts similar to those in the given arch *a c g e b d*, take a small beam compass, and having fixed its points at any convenient interval, upon the centres *e*, *g*, being the given points of the divided arch, strike the small arches *f i*, *h k*, &c. cutting the undivided arch in *f*, *h*, then will the intercepted arches as *f h* be similar to the arches *e g*; that is, they will subtend the same angles at their common centre *o*. For joining *e f*, *g h*, and also *o f*, *o h*, *o e*, *o g*, the triangles *e o f*, *g o h* will be similar and equal to each other; every side in the one being respectively equal to every side in the other. Taking away, therefore, the common angle *e o h* from the equal angles *e o f*, *g o h*, the remaining angles *e o g*, *f o h* will also be equal. If the triangles *e f o*, *g h o* be right angled at *f* and *h*, the dividing strokes *f i*, *h k*, &c. will cut the quadrantal arch *f h t*, at right angles also at *f* and *h*.

In Fig. 4. *a b c d* represents a square piece of brass (with several steady pins in it) screwed to the flat bars at the centre of the quadrant, the screw holes being so large as not to touch the screws; and *k l m n* represents a thick circular plate of brass, with a hollow pipe *f g* fixed perpendicular to the middle of it. This plate was turned exactly circular in a lathe upon a brass arbor *o i*, turned tapering, and a little hollow in the middle, so as to fit the cavity of the pipe *f g*, and to bear against it chiefly at both ends. When the hollow pipe *f g* is put through the holes (exactly fitted for it) in the middle of the square *a b c d*, the brass circle *k l m n* is fixed to the plane of the square *a b c d*, with screws and steady pins. The point *o* in the pole of the arbor *o i* is not only the centre of the circular neck *k l m n*, about which the telescope must turn, but also the very centre upon which the divided arches were struck upon the limb of the quadrant. The end of the telescope which holds the object glass lies across one end of an oblong plate of brass *s t*, at right angles to its sides, and is fixed to the plate by a brace capable of being widened and narrowed with a screw. Near the other end of the plate *s t*, there is a round hole lined with a steel collar *p q r*, to be put over the brass neck *k l m n*, and to turn round upon it. The section of this collar, taken at right angles to its plane, is shown at *z*, the broader of the two rings being under the plate *s t*, and contiguous to the square plate *a b c d*. Over this neck and collar there is fixed a brass spring shown at *v*, and screwed to the neck *k l m n*, to keep the collar from slipping from it; and over all these is screwed a cap, shown at *x*, to cover the centre work; and to keep off the dust, which is also prevented from coming between the plates *a b c d* and *s t* to the neck and collar, by means of a brass hoop surrounding the broad rim or base of the collar *p r*, and screwed to the backside of the plate *s t*; which hoop is received into a circular groove 1, 2, 3, 4, formed in the square plate without touching any part of it.

The superiority of this centre work consists in preserving the place of the central point of the quadrantal arch in the pole of the arbor *o i*. For whenever an unsteady motion of the telescope round the centre of the quadrant shall arise from the wearing of the neck plate *k l m n*, a new neck plate and pipe may be cast, well hammered, and turned upon the poles of the same arbor *o i*, to fit the hole and collar, and then it will move the telescope round the centre of the limb as correctly as when it was new.

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* A part of this process of dividing the limb has already been given under GRADUATION; but we have repeated it here, in order that the complete description of this quadrant may be read at once.

We have represented in Fig. 5. the quadrant fixed to the eastern side of a freestone wall, built on purpose in the plane of the meridian. 1. The whole weight of the quadrant is sustained by two strong iron pins fixed to the wall, as afterwards described, and projecting through two holes, made in two square plates of iron rivetted to the quadrant at *a* and *b* in Fig. 1. The pin at *a*, which bears the greater part of the weight, is immoveably fixed in the wall, but the pin at *b* can be screwed up or down by a strong screw in order to bring one side of the quadrant to a horizontal, and the other to a vertical position.

Fig. 6. shows the method in which the pin *b* is moved. An oblong plate of iron *l m n o* is let into the freestone wall, and fastened to it by bolts of iron, which pass through the wall, and through another plate let into the opposite side of it, the bottom of each plate being bent square and bedded in the stone. The heads of four iron screws are shown at *e, f, g, h*, having the shanks going through four long slits made in another iron plate, shown by the smaller parallelogram, and screwed into the fixed plate *l m n o*. The moveable pin *b c* is fixed to the lesser plate, which is raised or depressed by means of a long screw *k i* working against the bottom of the pin *b c* at *d*, being turned round in a strong concave screw fixed to the bottom of the larger plate at *p q*. The key for turning the long screw *k i* is a sector of a circular plate shown at *r s t*, the square hole in its centre *t* being put upon the shank *k*. The radius of the key is just so big as to move in the space between the wall and the bars of the quadrant, and a chisel *v* is inserted into the teeth, upon the arch of the key, to increase the power of moving it.

The plane of the quadrant is fixed to the wall, and adjusted in any position by nearly the same number of holdfasts as there are little squares round about the quadrant, as in Fig. 2. Each holdfast consists of two separate parts, one of which is fixed to the wall, and the other to the quadrant.

A transverse section of the wall *a b* is shown in Fig. 7. where *c, c*, &c. are the holdfasts. Between the chops of each, shown at *d e*, there passes one end of a small brass plate, having its plane parallel to that of the quadrant, the other end being bent to a right angle, and rivetted to the perpendicular bars of the quadrant. Each plate is, besides, pinched by two opposite screws *r s*, which work through the chops *d e*, made pretty wide for the purpose of adjusting the position of the plane of the quadrant. Another use of the screws in the chops was, in the event of the wall or quadrant swelling or shrinking, so to alter their proportions that the brass plates might slide without distending the instrument. As lead is apt to yield, the holdfasts are fastened in the wall with a composition of stone, dust, pitch, and brimstone, or rosin such as stonecutters use for cementing broken stones.

The next point of importance is to balance the telescope, so that it may have a free and easy motion round the centre of the quadrant. This is done by the method shown in Fig. 5, where *a b* is an iron axis laid across the top of the wall, having two brass plates fixed perpendicular to the ends of it, with notches or holes cut in them for the axis to turn in, which points to the centre of the quadrant at right angles to its plane. To the end of the axis next the quadrant, is fixed an iron arm *c d*, having two brass plates *c e, d f*, almost perpendicular to it, and to them are rivetted two slender slips of fir, whose other ends meet at *g*, near the eye-glass, being held together in a brass cap or socket. Through a small plate fixed to one side of a collar, embracing this lower end of the telescope, there passes a screw-pin at *g*, parallel to the telescope; which pin being screwed into the cap at the end of the slips, keeps up the telescope tight against the centre work. The slips are strengthened by five or six cross braces of the same wood, as represented in the figure. To the other end of the axis *a b*, another arm *h i* is fixed parallel to the telescope, and in a contrary direction, carrying a weight *i* to counterpoise the weight of the telescope, and make it rest in any position. And for greater ease and freedom of its motion, two small brass rollers are fixed to each side of it, at *k* and *l*, which are held tight to the plane of the limb by a plate springing against its backside, which plate has also a roller at each end of it.

When the telescope is pretty nearly directed to an object whose altitude is to be taken, a plate *m n*, which is carried by the telescope along the limb and lies across it, may be fixed to it by a screw, not here represented. Then by twisting the head *o* of a long screw *o p*, which is parallel to the limb, and which works through a female screw annexed to the plate *m n*, and whose neck at *p* turns round in a collar annexed to the telescope; a very gradual motion is given to the telescope for bringing the cross hairs exactly to cover the object.

To avoid the trouble of subdividing the quadrantal arch into smaller parts, the telescope carries a small brass plate, which slides upon the limb, and is called a *Nonius*, from the name of its inventor. To understand the reason and use of this plate, it is convenient to premise the following theorem:—If a line *a f* be divided into any number of equal parts, *a b, b c, c d, d e*, and an equal line $\alpha\epsilon$ be divided into other equal parts, $\alpha\beta$, $\beta\gamma$, $\gamma\delta$, $\delta\epsilon$, whose number is one less than the number of parts in *a f*; then $\alpha\beta$, $\alpha\gamma$, $\alpha\delta$, $\alpha\epsilon$, will exceed *a b, a c, a d, a e*, respectively, by one, two, three, four parts of *a b*, whose denominator is the number of parts in *a e*, or in $\alpha\epsilon$. For, let the lines *a f*, $\alpha\epsilon$, be coincident at both ends, and since any equimultiples of two quantities, *a b*, $\alpha\beta$, are in the same ratio as the quantities themselves, (Euclid, v. 15,) it will be as $ab : \alpha\beta = ac : \alpha\gamma = ad : \alpha\delta = ac : \alpha\epsilon$, or *af*, and disjointly as $ab : b\beta = ac : c\gamma = ad : d\delta = ae : e\epsilon$, or *ef*. The consequents $b\beta$, $c\gamma$, $d\delta$, $e\epsilon$, are therefore in the same arithmetical progression as the antecedents *a b, a c, a d, a e*, and the first of the consequents $b\beta$; is the same part of its antecedent *a b*, as the last consequent *e f* is of its antecedent *a e*, or as $\alpha\beta$ is of $\alpha\epsilon$, the number of parts in *a e* and $\alpha\epsilon$ being equal by the first supposition. And it is manifest, that any two equal and coincident arches of a circle have the same property.

The upper arch AB, Fig. 9, represents a degree divided into 12 equal parts, each containing five minutes; and the under arch, CD, a 96th part of the quadrant divided into 16 equal parts; and EF, the Nonius or subdividing plate fixed to the telescope, and sliding with it in the space between the arches AB and CD. Both these divisions are numbered from left to right, commencing from the intersection of the vertical radius, in order to measure the distances of objects from the zenith; but the parts on the Nonius, are numbered the contrary way, beginning from the line 00, produced through the centre of the quadrant. In the figure the Nonius EF is so situated, that the upper end of the index 00 is not opposite to any one line upon the adjacent arch, but to some point of a 12th part of a degree intercepted between 50 and 55 minutes. To find the excess above 50, it will be seen by looking back Fig. 9.

Plate CCCCLXXVI. Fig. 9.

from the index, that a division line of the Nonius, which lies between the numbers 3 and 4, is exactly opposite to a division line upon the adjoining arch, which shows that 3½ minutes is to be added to the 50 minutes. For since a degree is divided into 12 equal parts, each containing 5 minutes, and since the length of the Nonius is made equal to 11 of these parts, and divided into 10 equal parts, it appears by the preceding Theorem, in counting back again from the coincident division lines to the index, that the first part of the Nonius exceeds the first upon the limb by 1-10th of this latter part, that is by 1-10th of 5 minutes, which is half a minute, and consequently that seven parts of the Nonius, from the coincident division lines to the index, exceed the seven corresponding parts of the arch by seven half minutes or 3′ 30″.

When no one division line upon the limb is exactly opposite to a division line upon the Nonius, then we must look for that single part of the limb which is so opposed to a single part upon the Nonius, as to be exceeded by it at both ends, as shown in the parts G, H, Fig. 9. Then if that part of the Nonius appears to the eye to exceed the part of the limb equally at each end, 15″ more must be allowed than if they had coincided at their ends next the index; and according as the excess next the index is judged to be *one-third*, *one-half*, *double*, or *treble*, of the other excess, we must allow 7½″, 10″, 20″, 22½″, respectively. For as the sum of the two excesses is always the same, and is equal to 30″, (as is obvious when one of them is diminished to nothing,) the number of seconds to be added will always be to 30″, as the excess next the index is to the sum of the two excesses.

The lower arch of the Nonius is divided into 16 equal parts, and is equal in length to 17 equal parts upon the opposite arch, and therefore will determine 16th parts of every one of them, by the theorem and method above mentioned. In Fig. 9, the opposite division lines of the Nonius and the lower arch are supposed to coincide at the end of the 9th part upon the Nonius, which shows that the index cuts off 9-16ths of the opposite part of the arch. And so the length of the arch from the beginning of a 96th part of the quadrant, is thus denoted 15,9, the lower pointer being past the 15th stroke.

This way of subdividing by a Nonius, is preferable to the common method of drawing diagonals, both because the trouble of drawing so many diagonals is entirely avoided, and also because they cannot be drawn so exactly by the edge of a ruler, as the lines upon the Nonius; and lastly, because the intersection of these diagonals with the index or fiducial edge, (as they call it,) by reason of the great obliquity to each other, cannot be determined so exactly by the eye as the coincidence of two division lines in the Nonius, and the arch, which stand directly opposite to each other.

The object-glass being firmly and permanently fixed in the telescope, the Nonius plate *c d*, and the collar plate *s t*, were both screwed fast to the telescope when taken off from the quadrant, and then the line of sight was brought to be parallel to the line *c o*, drawn through *o* the centre of the collar *p q* to *c*, the beginning of the divisions on the Nonius, in the following manner: The lines *s o t* and *e c f* being drawn upon these plates both perpendicular to *o c*, any distances *o t* and *c f* were taken equal to each other, on one side of *o c*, and any other distances *o s* and *c e* (long enough to go beyond the telescope,) were also taken equal to each other on the opposite side of *o c*. Through the four points *e*, *s*, *t*, *f*, the ends of the two plates were filed exactly parallel to *o c*. Then placing the points *t f* upon two points *m n* of an horizontal line, drawn upon a firm plane, a point of a remote object covered by the cross hairs, was marked. The telescope being then turned half round, its axis *a b*, and the opposite points *e s* of the plates being placed upon the same points *m n*, another point of a remote object now covered by the cross hairs, was also marked; and the telescope remaining fixed, the cross hairs were moved in its focus, till after several repetitions of the operation, the same point of the object was covered by them in both positions of the telescope; and then the line of sight was exactly parallel to the line *o c*, supposing the object to be remote. But because smaller marks upon a nearer object are better discerned, the hairs were so adjusted, till in each position of the telescope they covered a separate mark, the interval of the marks being taken equal to the difference of the heights of the axis of the telescope above the fixed line *m n*, as near as could be measured.

The object glass being well centred, the line of sight was first of all made parallel to the plane of the quadrant, as near as it need be, by the measures of the brass work annexed to the telescope; and then the plane described by the line of sight, turned about the centre of the quadrant, was brought into the plane of the meridian, by observing whether the fixed stars passed over the cross hairs at the same instant of time, as they passed over a meridian telescope, adjusted as above described, and placed so near the quadrant that the two observers would hear each other calling out at the times of the transits. And by the coincidence of these observations upon stars at various altitudes, it appeared that the plane of the quadrant was wrought very true. For it is certain that the meridian plane described by the meridian telescope as turning upon a transverse axis, must be truer than that described by the quadrantal telescope, as guided by the rollers upon the limb.

When the quadrant was thus reduced into the plane of the meridian by the holdfasts above described, that radius of it which terminates 90 degrees, was placed exactly vertical (by the movement above mentioned,) with a plumb line of very fine silver wire; so suspended as to play exactly over the middle of the central point *o* (in the pole of the arbor *o i*,) and also over the stroke at 90 degrees upon the limb below. This position of the quadrant being once found, another plumb-line was suspended by the side of the quadrant, quite clear of the centre work, so as to play exactly over the middle of a fine point made in the limb below, in order to examine afterwards with more expedition, whether the quadrant has kept its place. For this purpose an oblong piece of brass *ab*, laid flat upon the square plate at the centre of the quadrant, was gradually moved to the right or left by two screws *c*, *d*, working against the ends of it: a slit *a b* being cut lengthwise through the plate to slide along two other screw-pins, *e*, *f*, fixed in the back plate. The wire of the plummet was hung by a loop upon a pin *g*, and lay in a very fine angular nick, filed in the edge of a little plate *h*, which projected a little farther than the loop for the wire to bear upon it. This plate *h*, and the pin *g*, were both fixed to the oblong plate *a b*; by whose gradual motion, above described, the wire *h i* was brought to play exactly over the middle of the hole *i* in the limb; and then the plate *a b* was pressed to the quadrant by the screws *e*, *f*.—Smith's *Optics*, Vol. II. p. 332-341.

In the year 1753 a quadrantal arc of 96°, with its subdivisions, was inserted in this quadrant by Bird, between the two original divided arcs, and all the observations since made with that instrument are referred to this new arch.

2. *Description of Bird's Mural Quadrant.*

The Mural Quadrant of Mr. Bird was constructed on the model of Graham's, and was made entirely of brass. It was erected in the time of Dr. Bradley in 1750, and was used by that astronomer and Dr. Maskelyne in their most valuable observations. The radius of that instrument is eight feet. Near the eye-piece of the telescope there is a good micrometer, for giving it a slow motion, and for measuring the number of seconds that the reading lines of the vernier want of coincidence in any observation. As Mr. Smeaton recommended, however, the vernier is no longer used, and the last 5′ space in the observed arc is subdivided by the screw.

Mr. Pond having had reason for suspecting the accuracy of the total arc of the quadrant, Mr. Troughton examined it by an apparatus contrived for the purpose. He found the total length of the quadrantal arch 7″ too small, and he discovered a similar error of 2″, arising from the wear of the axis of motion. In the intermediate division he could not detect more than *one second* of inequality. The difference of the readings of the two arcs has never been observed to exceed 4″, which proves the great accuracy of Bird's graduation. The diminution of 7″ in the total arch seems to be occasioned solely by a change of figure in the space of 48 years, as Dr. Bradley found the arc to be exactly 90° in 1759.

Mr. Troughton has not examined the quadrantal arch of Graham's quadrant, but he is of opinion that, being made of iron, it has preserved its form better than Bird's, which was made of brass.

3. *Cole's Quadrant by a single Reflection.*

This instrument, invented by Mr. Benjamin Cole, is composed of a moveable radius AB, Plate CCCCLXXVI. Fig. 10. a quadrantal arch DE, three vanes A, B, C, and a vernier FG. The moveable radius is a piece of wood about 2 inches long and 1½ thick. The quadrantal arch is also of wood, and has a radius of 9 inches, being divided into degrees and third parts of a degree. The sight vane A, a thin piece of brass about 2 inches high and 1 broad, is placed perpendicularly at the end of the radius A, and through the middle of it is a small hole, through which the coincidence of the horizon and solar spot is to be viewed. The horizon vane B, about 1 inch broad, and 2½ high, has a slit cut through it about 1½ inch long and ¼ broad. It is fixed in the centre pin of the quadrant perpendicularly, and is always inclined 45° to the sight vane. The shade vane C consists of two brass plates, one of which revolving on an arm, is about 4½ inches long, and ¾ths of an inch broad. It is pinned at one end to the upper limb of the quadrant by a screw, about which it has a small motion. The other end lies in the arch, and the lower edge of the arm is directed to the middle of the centre pin. The other plate, which is properly the vane, is about two inches long, and is fixed at right angles to the first plate, at the distance of about half an inch from the end next the arch. This vane may be used either by the shadow which it casts, or by the solar spot formed by a convex lens placed within it. In order to rectify this vane, set the line C of the vernier opposite to a degree on the upper limb of the quadrant, and turn the screw on the back side of the limb forward or backward till the hole in the sight vane, the centre of the glass, and the sunk spot in the horizon vane, all lie in the same straight line. In order to take the altitude of the sun by that quadrant, turn your back to the sun, and hold the instrument by the radius AB with your right hand, till it is in a vertical plane passing through the sun, then looking through the sight vane and the horizon vane till you see the horizon, move the quadrantal arch upward with the left hand, till the shadow of the sight vane or the solar spot formed by the lens fall directly on the slit in the horizon vane. When that is done, the part of the quadrant raised above G or S, according as the solar spot or shade is viewed, will be the altitude of the sun required.

4. *Description of Gunter's Quadrant.*

Description of Gunter's Quadrant.

This quadrant, invented by Edmund Gunter, Professor of Astronomy in Gresham College, has been in use since 1618. It is commonly made of wood, with its limb divided into 90°, and two sight vanes placed in one of the radii next the division of 90°. It has likewise a stereographical projection of the sphere on the plane of the equinoctial, and a kalendar of the months close to the divisions on the limb. The indications on the limb are obtained by a plummet-line with a moveable bead. The places of five stars are also laid down on the quadrant, so that a series of astronomical problems can be performed with the quadrant in the same manner as with a celestial globe. Thus, 1st, If the thread is laid to the day of the month, it will cut on the limb the degree of the sun's meridian altitude, and *vice versa*. 2d, If the bead is slid on the thread to the sun's place in the ecliptic, and if the thread be made to cut on the limb the sun's meridian altitude, as observed with the quadrant, the bead will fall upon the hour of the day. 3d, If the bead is first laid to the sun's place, and then on the given hour of the day, the thread will cut the sun's altitude on the limb. 4th, If the bead is set to the sun's place, and the thread moved to the line of declination, the bead will cut the sun's declination. 5th, The bead being rectified to the hour of the day, as in art. 2, and the sun's altitude observed, bring the thread to the complement of the altitude, and the bead will point out the sun's azimuth among the azimuth lines. 6th, The thread being laid upon the sun's place in the ecliptic, it will point out on the limb his right ascension, and *vice versa*. 7th, In order to find the hour of the night from any of the five stars laid down on the limb, put the bead to the star to be observed, and, by art. 2, find how many hours it is from the meridian. From the star's right ascension subtract the sun's right ascension in time, and add this difference to the observed hour of the star from the meridian, the sum is the hour of the night.

5. *Description of Sutton's or Collins' Quadrant.*

Description of Sutton's or Collins' Quadrant. Fig. 11.

This quadrant, see Fig. 11, fitted to the latitude of London, contains a stereographic projection of one quarter of the sphere between the tropics, the eye being in its north pole. The lines which run from right to left are parallels of altitude, and those which cross them are azimuths. The lesser of the two circles which bound the projection is one-fourth of the tropic of Capricorn, and the greater is one-fourth of that of Cancer. From a point on the left edge of the quadrant are drawn the two ecliptics, having the signs of the zodiac, and from the same point are drawn the two horizons. The limb is graduated both into degrees and hours, and, from the sun's altitude, the hour of the day may be found to a minute. The divided quadrants nearest the centre contain the kalendar of months, and beneath them is the sun's declination. Several of the most remarkable stars between the tropics are laid down on the projection, and immediately below the projection is the quadrant and line of shadows. The method of using this quadrant is nearly the same as that of Gunter's.

6. *Description of the Horodictical Quadrant.*

Description of the horodictical quadrant.
PLATE CCCCLXXVI.
Fig. 12.

This little instrument derives its name from its property of telling the hour of the day, and is made as follows: The quadrant CAB, Fig. 12. has its limb AB divided into 90°, and round its centre C are described seven concentric circles, having the signs of the zodiac added to them. A ruler is now applied to the centre C and the limb AB, and on the several parallels are marked the degrees corresponding to the altitudes of the sun when in those degrees, for the given hours. The points belonging to the same hour are then connected by a curve line, and the number of the hour added. A pair of sights are now fitted to the radius CA, and a thread furnished with a plummet, and a sliding bead, is attached to the centre C. By bringing the bead to the parallel on which the sun is, and directing the quadrant to the sun till a solar ray passes through the sights, the bead will point at the hour of the day, as the plummet-line cuts all the parallels in the degrees corresponding to the sun's altitude. As the bead is in the parallel which the sun then describes, the bead must show the present hour, even though hour-lines pass through the degrees of altitude to which the sun rises every hour.

7. *Description of the Sinical Quadrant.*

Description of the sinical quadrant.
Fig. 13.

This instrument, Fig. 13, which is chiefly of use in navigation, consists of several concentric quadrantal arches, divided into eight equal parts by radii, with straight lines crossing one another at right angles, and parallel to the rectangular radii.

Any one of the arches, as BC, is used to represent the horizon, or meridian, though it may represent a quadrant of any great circle of a sphere. If BC is taken as a quadrant of the horizon, either of the sides, as AB, may represent the meridian; and the other sides as AC will represent a parallel, or line of east and west; while all the other lines parallel to AB will be also meridians, and all those parallel to AC east and west lines, or parallels.

The eight equal parts into which the limb is divided by the radii contain 11° 15′, and represent the eight parts of the compass on the quarter of the horizon. The arch BC is divided into 90°; and by means of diagonal lines each degree is subdivided into twelve parts, or five minutes each. A thread is fixed to the centre, and divides the horizon, by being laid over any degree of the quadrant.

If this quadrant is taken to represent a quarter of the meridian, one of its sides AB may be taken for the common radius of the meridian and the equator, and then the other AC will be half the axis of the world. The degrees of the circumference BC will represent degrees of latitude, and the lines parallel to the side AB assumed from every point of latitude to the axis AC, will be the radii of the parallels of latitude, and likewise the cosines of these latitudes.

If it is now required to find the degrees of longitude contained in 83° of the lesser leagues in the parallel of 48°. Lay the thread over 48° of latitude, on the circumference, and count the 83 leagues from A upon AB. These will terminate at H, allowing for every small interval four leagues, and the interval between the broad lines twenty leagues. By then tracing out the parallel HG from the part H to the thread, the part AG of the thread will show, that 125 greater, or equinoctial leagues, make 6° 15′; allowing 20 leagues to a degree, and 3′ for one league; and, consequently, that 83 lesser leagues AH, which make the difference of longitude of the course, and are equal to the radius of the parallel GI, make 6° 15′ of the above-mentioned parallel.

When the ship sails on an oblique course, this course, besides the north and south greater leagues, gives lesser leagues easterly and westerly, to be converted into degrees of longitude of the equator. But as these leagues are made neither on the parallel of departure, nor on that of arrival, but in all the intermediate ones, a mean proportional parallel between them must be found. For this purpose, the quadrant has a scale of cross latitudes, so that we have only to take with the compasses the middle point between the parallels of which we want the mean, and the middle point will be the mean parallel required.

The chief use of the sinical quadrant, is to form triangles upon it similar to those made by a ship's course with the meridians and parallels; the sides of these triangles being measured by the equal intervals between the concentric quadrants, and the lines of N. and S. E. and W. Every fifth of the lines and arcs is distinguished by a broader line, so that if each interval is made to stand for a league, there will be five between two adjacent broad lines; or if each interval represent four leagues, there will be twenty leagues, or a sea degree, between two adjacent broad lines.

If we suppose a ship to have sailed 150 leagues north-east, one-fourth north, which is the third point, and makes an angle of 33° 45′ with the north part of the meridian, then making A the place of departure, reckon by means of the concentric arch along the point the ship sailed on, as AD, 150 leagues from A to D, then is the point D the point of the plane to which the ship has arrived. Let DE be the parallel to the side AC, and we shall then have a right angled triangle AED, similar to that of the ship's course, difference of longitude and latitude. The side AE gives 125 leagues for the difference of latitude northwards, which makes 6° 15′, reckoning twenty leagues to a degree; and the side DE gives eighty-three lesser leagues, answering to the parallels which, when reduced as above shown, will give the difference of longitude.

8. *Description of the Common Gunners' Quadrant.*

This instrument, represented in Fig. 14, consists of two branches, made of wood or brass, one of which is about twelve inches long, eight lines broad, and one line thick; and the other four inches long. Between these branches is placed a quadrant, divided into 90°, the divisions, commencing at the shorter branch, which is furnished with a thread and plummet.

The use of the quadrant is to point cannons, mortars, &c. which is done by placing the longest branch in the mouth of the piece of ordnance, and by elevating the piece, till the plumb line rest at the degree of elevation required.

Description of Mr Irving's substitute for the Gunner's Quadrant.

As one of the objects of the Gunner's Quadrant is to point guns precisely in the same manner when the visual line does not bear on the object, and when the object aimed at is hit by the gun at a particular elevation; the following instrument, which answers the purpose much better, was contrived by Alex. Irving Esq. when first Lieutenant of the Edinburgh Corps of Artillery. It is represented in a front and back view in Fig. 15. and 16. The following is Mr. Irving's own description of it. " Breadth of the aperture, one inch; length, one and a half, which is divided by a scale, into 18 parts, each of which, when the length of the gun (this calculation applies to the ordinary light six-pounders) is made radius, will be equal to five minutes. The Nonius dividing plate which is fixed to the horizontal moveable wire, being divided into five parts, which altogether are equal to four divisions of the scale, will give a division into minutes.

The two feet of the instrument rest upon the upper part of one of the muzzle mouldings of the gun, on which it is kept by a steel spring. The spirit level must be parallel to the line joining the feet, and at right angles to the vertical wire. The view of the back part will show the mode in which the Nonius and horizontal wire are raised and lowered by means of a screw.

The aperture is bisected vertically by a black wire, which is cut at right angles by a horizontal wire. The latter, however, must not be a wire, but a thin plate set edgewise, that it may bear being raised or lowered.

When it arrives at the opposite side of the instrument, it is flattened in a contrary direction, and kept close to the limb of the instrument by a slip of metal, which, however, allows it to move freely up and down.

In using the instrument, says Colonel Macdonald, the horizontal wire can be depressed or elevated till its intersection with the perpendicular one cuts some point on the object, and, by bringing the intersecting point on the same part of the object in all succeeding shots, the gun will be always similarly pointed. The angle of elevation of field-pieces seldom exceeds the degree which that instrument is capable of ascertaining, and it might easily be rendered capable of measuring larger angles than are usual in field service. See Colonel Macdonald's work *On Projectiles, Fuzes, &c.* pp. 59, 60. Lond. 1819.

For farther information on the subject of Quadrants, see Bion *on the Construction and Principal Uses of Mathematical Instruments;* Smith's *Optics*, vol. ii. chap. vii. p. 332; " *The Method of Constructing Mural Quadrants*," published by order of the Commissioners of the Board of Longitude, in the year 1768; Vince's *Treatise on Practical Astronomy;* Grandjean de Fouchy's Machine for Managing a Quadrant, in the *Mem. Acad.* 1740, p. 468; or *Machines Approuvées*, vii. p. 47. A quadrant with a reflecting Telescope is described in the *Mem. Acad. Par.* 1746, Hist. p. 121; Gersten's *Quadrantis Muralis Idea Nova*, in the *Phil. Trans.* 1747, vol. xliv. p. 507; Fouchy *on Converting a Quadrant into an Azimuthal Instrument*, in the *Mem. Acad. Par.* 1781, p. 259; Caesaris *de Quadrante Murali Mediolanensi Ramsdeni*, 8vo. See SEXTANT.

QUADRATIC EQUATIONS. See ALGEBRA, Vol. I. p. 445.

QUADRATURE. See GEOMETRY, Vol. X. p. 221; and FLUXIONS, Vol. IX. p. 447.

QUADRUPEDS. See MAMMALIA.

QUAKERS, or FRIENDS. The tenets more peculiarly held by this society were first promulgated by George Fox, about the year 1647. He, on this account, often suffered persecution. In the year 1650 he was imprisoned at Derby, and it was here that the name of QUAKERS was first given to George Fox and his friends, by one of the Justices who committed him, because he had bid them to " tremble at the word of the Lord." This appellation soon became, and has since continued to be, their usual denomination; but they themselves adopted the appellation of FRIENDS.

During the time of the Commonwealth much personal abuse was bestowed on them; imprisonment was common; and stripes, under pretence of vagrancy, were inflicted without regard to sex, and on persons of unimpeachable character, and of good circumstances in the world. Although the practice of inflicting corporal punishment on this people seems in England to have fallen into disuse at the restoration, yet the reign of Charles II. must be considered as the time of their greatest suffering. Their imprisonments were long, often terminating only with the life of the prisoner. The crowds shut up together increased, in many places, the ordinary sufferings of confinement; which, in some cases, were augmented by the barbarity of gaolers. The fines imposed were exacted with a rigour that generally oppressed the sufferer, and sometimes left him nearly destitute of household goods; and several families experienced a separation of the nearest connexions of life, by the execution of a law which subjected the members of this society to banishment. The king, as a branch of the legislature, joined in the enactment of these laws; nevertheless, he did not seem in all cases to countenance severity, for he was the means of affording relief in the most sanguinary persecution which the Friends ever experienced. This was in New England, where it was made penal for a Quaker even to reside. The government of that province first imprisoned them, next employed the scourge, which was followed up by cutting off their ears; but all this proving insufficient to deter the Friends from returning to New England in order to preach the Gospel, which they believed to be a duty required of them by the divine will, a law was enacted to banish them on pain of death. Their constancy, however, was not thus to be shaken, and four Friends, one of whom was a woman, were hanged at Boston. In this extremity, application was made to Charles II. who willingly granted his *mandamus*, dated 9th September, 1661, to stop these severities. The Quakers, in common with other dissenters, were relieved by the suspension of the penal laws under James II. But it was not until the reign of King William that they obtained any degree of legal protection. In the year 1681 Charles II. granted to William Penn the province of Pennsylvania. Penn's treaty with the Indians on this occasion, reflects honour on his memory, and forms a striking contrast with the conduct of other colonists. In the government which he formed, he allowed that full liberty of conscience, which he and his friends had themselves claimed from their fellow-professors of the Christian name. If the Independents have the credit of being the first who held the principles of toleration, the

Friends have the credit of being the first who reduced those principles to practice. In the early times of this Society, a few individuals belonging to it were chargeable with irregularity and impropriety in some parts of their conduct, but we believe that, on examination, it will be found that such conduct was disapproved of by the Society at large. The most notorious instance of the kind is that of James Naylor, who was condemned on a charge of blasphemy by Cromwell's parliament; but when it is considered that he was disowned as a member by the society, and was not reinstated until he had publicly acknowledged his error, and given signs of sincere repentance, it is certainly unfair to affix any stigma to the Friends on his account; yet this has been done by several writers.

The doctrines of the Society of Friends have been variously represented, but we shall give the reader an account of their tenets nearly in their own words, leaving him to judge for himself.

1. They believe that God is one, and there is none other besides him, and that this one God is Father, Son, and Holy Ghost, as in Matt. xxviii. 19. (R. Claridge.) To the assertion that the Quakers deny the Trinity, William Penn answers, "Nothing less. They believe in the Holy Three, or the Trinity of Father, Word, and Spirit, according to the Scripture: but they are very tender of quitting Scripture terms and phrases for schoolmen's, such as distinct and separate persons and subsistencies, &c. from whence people are apt to entertain gross ideas and notions of the Father, Son, and Holy Ghost," &c.

2. They believe that Christ is both God and man, in wonderful union, not a God by creation or office, as some hold, nor man by the assumption of a human body only, without a reasonable soul, as others, or that the manhood was swallowed up of the godhead, as a third sort grossly fancy; but God uncreated, (see John i. 1, 3. Coloss. i. 17, &c.) the true God, (1 John, v. 20,) the great God, (Tit. ii. 13, &c.) And man, conceived by the Holy Ghost, and born of the Virgin Mary, (see Luke i. 31, 35,) who suffered for our salvation, and was raised again for our justification, and ever liveth to make intercession for us. In reply to the charge, that "the quakers deny Christ to be God." William Penn says, "a most untrue and uncharitable censure; for their great and characteristic principles being this, that Christ, as the divine word, lighteth the souls of all men that come into the world with a spiritual and saving light, according to John i. 8, 9, 12, (which nothing but the Creator of souls can do,) it does sufficiently show they believe him to be God, for they truly and expressly own him to be so, according to the Scripture, viz. in him was life, and the life was the light of men, and he is God over all, blessed for ever." And to the objection, that "the quakers deny the human nature of Christ," he answers, "we never taught, said, or held so gross a thing. For, as we believe him to be God over all, blessed for ever, so do we truly believe him to be of the seed of Abraham and David after the flesh, and therefore truly and properly man, like us in all things, sin only excepted." (William Penn.)

3. *On the Scriptures.*—They believe them to be of divine authority, given by the inspiration of God through holy men; that they are a declaration of those things most surely believed by the primitive Christians, and that they contain the mind and will of God, and are his commands to us, and therefore are obligatory on us, and are profitable for doctrine, for reproof, &c. They love and prefer them before all other books in the world, rejecting all principles or doctrines whatsoever that are repugnant thereunto; indeed, no society of Christians in the world can have a more reverend and honourable esteem for them than they have. (William Penn.) Nevertheless, they object to calling the Scriptures the word of God, as being a name applied to Christ as the eternal word by the sacred writers themselves, though too often misunderstood, and therefore misapplied, by those who extol the Scripture above the immediate teaching of Christ's spirit in the heart; whereas, without the last, the first cannot be profitably understood.

4. *On the Resurrection.*—They believe the resurrection according to the Scripture, not only from sin, but also from death and the grave; they most steadfastly believe, that as our Lord Jesus Christ was raised from the dead by the power of the Father, and was the first-fruits of the resurrection, so every man in his own order shall arise, they that have done well to the resurrection of eternal life, but they that have done evil to everlasting condemnation; and as the celestial bodies do far excel the terrestrial, so they expect our spiritual bodies in the resurrection shall far excel what our bodies now are. (William Penn and William Sewell.)

5. *On the Original and Present State of Man.*—William Penn says "the world began with innocency, all was then good that God had made; man in paradise, the beast in the field, the fowl in the air, &c. worshipped, praised, and exalted his power, wisdom, and goodness. But this happy state lasted not long; for man, the crown and glory of the whole, being tempted to aspire above his place, fell below it; but the divine image, the wisdom, power, and purity he was made in, by which, being no longer fit for paradise, he was expelled that garden of God, and was driven out as a poor vagabond, from the presence of the Lord, to wander in the earth." Respecting the present state of man, Robert Barclay observes, "we cannot suppose that men, who are come of Adam naturally, can have any good thing in their nature as belonging to it, which he, from whom they derive their nature, had not himself to communicate to them. If then we may affirm, that Adam did not retain in his nature (as belonging thereunto) any will or light capable to give him knowledge in spiritual things, then neither can his posterity; for whatsoever real good any man doth, it proceeds, not from his nature, as he is man, or the son of Adam, but from the seed of God in him, as a new visitation of life, in order to bring him out of his natural condition.

6. *On Man's Redemption through Christ.*—They believe that God, who made man, had pity on him in the fall, and in his infinite goodness and wisdom, provided means for his restoration by a nobler and more excellent Adam, promised to be born of a woman; and which, in a signal manner, by the dispensation of the Son of God in the flesh, was personally and fully accomplished in our Saviour; and that, as truly as Christ overcame the spiritual enemy of mankind in our nature in his own person, so, by his divine grace being received and obeyed by us, he overcomes him in us. They believe that there is no way of being saved from sin and wrath eternal, but by that Christ alone who died at Jerusalem; there is no way of being saved by him, but by receiving him into the heart through a living faith. Respecting the doctrines of satisfaction and justification, William Penn says, "I shall first speak negatively, what we do not own. We cannot believe that Christ is the cause but the effect of God's love, ac-

cording to the testimony of the beloved disciple, (John, chap. iii.) "God so loved the world, that he gave his only begotten Son, that whosoever believeth in him should not perish, but have everlasting life." We cannot say that Christ's death and sufferings were a strict and rigid satisfaction for that eternal death and misery due to man for sin and transgression; for such a notion were to make God's mercy little concerned in man's salvation." Now, positively, what we own as to justification; "we do believe that Jesus Christ was our holy sacrifice, atonement, and propitiation, that he bore our iniquities, and that by his stripes we are healed of the wounds Adam gave us in the fall, and that God is just in forgiving true penitents upon account of that holy offering which Christ made of himself to God for us; and that what he did and suffered, satisfied and pleased God, and was for the sake of fallen man that had displeased God; and that by the offering up of himself, once for all, through the eternal Spirit, he hath for ever perfected those (in all times,) that are sanctified." It is their belief that every man coming into the world, is endued with a measure of the light, grace, or good spirit of Christ, by which, as it is attended to, he is enabled to correct the disorderly passions and corrupt propensities of his fallen nature, which mere reason is insufficient to overcome, for all that belongs to men is fallible, but by this divine grace which comes from him who hath overcome the world, the snares of the enemy are detected, his allurements avoided, and deliverance experienced through faith in its effectual operation, whereby the soul is translated out of the kingdom of darkness, and from the power of Satan, into the marvellous light and kingdom of God.

7. *On Worship.*—Being thus persuaded, that man, without the spirit of Christ inwardly revealed, can do nothing to the glory of God, or to effect his own salvation; they think this influence especially necessary to the performance of the highest act of which the human mind is capable, even the worship of our Heavenly Father, in spirit and in truth; therefore, they consider as obstructions to pure worship all forms which divert the attention of the mind from the secret influence of this unction from the Holy One. Yet they think it incumbent on Christians to meet often together in testimony of their dependence on God, and for a renewal of their spiritual strength. In the performance of this worship, they believe it to be their duty to maintain the watch by preserving the attention from being carried away by thoughts originating in the will of man, and patiently to wait for the arising of that love, which, by subduing these thoughts, produces an inward silence, and therein affords a true sense of their condition; believing even a single sigh, arising from such a sense of their infirmities and of the need they have of divine help, to be more acceptable to God than any performances, however specious, which originate in the will of man. Thus each not only partakes of the particular refreshment and strength which comes from the divine life in himself, but is a sharer with the whole body, as being a living member of the body, has a joint fellowship and communion with all, and hereby, a minister by being baptized into the states of those assembled, is enabled to exercise his gift to the real edification of the church. (R. Barclay's *Summary.*)

8. *On the Ministry.*—Hence it follows, that the ministry which they approve must have its origin from the same divine influence that they conceive essential to the right performance of every religious act. Accordingly, they believe that the renewed assistance of the light and power of Christ is indispensably necessary for all true ministry; and that this holy influence is not to be procured by study, but is the free gift of God to chosen and devoted servants, and as this gift is freely received, they believe, according to the command of Christ, (Mat. x. 8,) that it ought to be freely exercised by the Christian minister. Hence arises their testimony against preaching for him, and hence their conscientious refusal to support such ministry by tithes or other means. And being fully assured that male and female are all one in Christ, they conceive that women may equally with men be qualified for the ministry.

9. *On Baptism and the Lord's Supper.*—They hold, that as there is one Lord, and one faith, so his baptism is one in nature and operation, that nothing short of it can make us living members of his mystical body, and that the baptism with water administered by his forerunner John, belonged, as the latter confessed, to an inferior dispensation. With respect to the other rite, they believe that communion between Christ and his church is not maintained by that, or by any other external ceremony, but only by a real participation of his divine nature through faith; that this is the supper alluded to in the revelation: "Behold, I stand at the door, and knock: if any man hear my voice, and open the door, I will come in to him, and will sup with him, and he with me," (Rev. iii. 20.)

10. *On Oaths and War.*—With respect to the former of these, they abide literally by Christ's positive injunction, "Swear not at all." From the most excellent precepts and example of our Lord himself, and the primitive Christians, and from the correspondent convictions of the Holy Spirit in their own hearts, they are confirmed in the belief that wars and fightings are, in their origin and effects, repugnant to the gospel, which still breathes peace and good will to men.

11. They disuse those names of the months and days of the week which, having been given in honour of the heroes and false gods of the heathen, originated in their flattery or superstition; and the custom of speaking to a single person in the plural number, as having also arisen from motives of adulation. Compliments, superfluity of apparel and furniture, outward shows of rejoicing and mourning, &c. they esteem likewise incompatible with the simplicity and sincerity of the Christian life.

12. *On their Church-Government or Discipline.*—They have monthly, quarterly, and yearly meetings, so called from the times of their being held. A monthly meeting is usually composed of several particular congregations, situated within a convenient distance. Its business is to provide for the subsistence of the poor (for they maintain their own poor) and for the education of their offspring; to judge of the sincerity and fitness of persons appearing to be convinced of their religious principles, and desiring to be admitted into membership; to excite due attention to the discharge of religious and moral duty, and to admonish disorderly members, and if they should prove irreclaimable, to disown them. The society has always scrupled to acknowledge the exclusive authority of the priest to marry. All marriages amongst them are proposed to the monthly meeting for its concurrence, without which they are not allowed, and are solemnized in a public meeting for worship. Of such marriages the monthly meeting keeps a record; as also of the births and burials of the members.

Several monthly meetings compose a quarterly meeting, to which they send representatives, who produce, at the quarterly meeting, written answers, from the monthly meetings, to certain queries respecting the conduct of their members, and the meetings' care over them. The accounts thus received are digested into one, which is sent also in the form of answers to queries by representatives to the yearly meeting, and thus the state of the body is laid before the society at large. Appeals from the judgment of a monthly meeting are brought to the quarterly meeting, whose business it is also to assist the monthly meeting in any difficult case, or where they appear to be remiss in their care over the individuals who compose them.

The yearly meeting has the general superintendence of the society in the country in which it is established; and, therefore, as particular exigencies arise, it gives forth its advice, makes such regulations as appear to be requisite, or excites to the observance of those already made. Appeals from the judgment of quarterly meetings are here finally determined. There are, in all, nine yearly meetings, one in London, to which come representatives from Ireland, and eight in America.

Those who believe themselves required to speak in meetings for worship are not immediately acknowledged as ministers by their respective monthly meetings, but time is taken for judgment, that the meeting may be satisfied of their call and qualification. And in order that those who are in the situation of ministers may have the sympathy and counsel of those of either sex, who, by their experience in the work of religion, are qualified for that service, the monthly meetings are advised to select such, under the denomination of elders. These, with the ministers approved by their monthly meetings, have meetings peculiar to themselves, called meetings of ministers and elders, in which they have an opportunity of exciting each other to the discharge of their several duties, and of extending advice to those who may appear to stand in need of it. Such meetings are generally held in the compass of each monthly, quarterly, and yearly meeting. The members of them unite with their brethren in the meetings for discipline, and are equally accountable to the latter for their conduct.

The foregoing account is principally compiled from the following works: "*A Summary of the History, Doctrine, &c. of Friends;*" R. Claridge's "*Life and Posthumous Works;*" William Penn's "*Works;*" R. Barclay's "*Apology;*" and Sewell's "*History of the Quakers.*"

QUANG-TON. See CHINA. Vol. VI. p. 209.

QUARLES, FRANCIS, an English poet, of moderate genius, was the son of James Quarles, Esq. of the Navy Board, and was born in 1592, at Rumford, near Essex. He received his education at Christ's College, Cambridge, and afterwards was entered at Lincoln's Inn. For some time he held the situation of cupbearer to the Queen of Bohemia, the daughter of James I.; and, upon his return, he received the situation of secretary to Archbishop Usher, in Ireland. The breaking out of the rebellion, however, in 1641, compelled him to return after the loss of his property. Our author had also held the situation of chronologer to the city of London, and he enjoyed a pension from Charles I. in consideration of his having made himself known by several works on religious subjects. One of his writings, called "*the Loyal Convert,*" gave great offence to the parliament; and his attachment to the king, which he evinced by joining him at Oxford, was punished by the loss of his estates, books, and MSS. These losses preyed upon his spirits, and he died in 1644, at the age of fifty-two.

Our author is chiefly known by his "*Divine Emblems,*" though he has written several works, both in prose and verse. This work consists of a set of designs exhibited in prints, and illustrated by some lines attached to each, and was once much admired by pious readers. His verses, though occasionally injured with bad taste, display many marks of real genius. See Headley's *Select Beauties of Ancient English Poetry,* and Mr. Jackson of Exeter's *Letters on Various Subjects.*

p. 352.

QUARTZ. See MINERALOGY. Vol. XIII. p. 545, 548.

QUASSIA. See MATERIA MEDICA. Vol. XIV.

QUEBEC, a city of North America, and the capital of the province of Lower Canada, is situated on a high point of land on the N.W. side of the St. Lawrence, at the confluence of the river St. Charles, and at the distance of about 320 miles from the Atlantic. The river is here contracted by a point of land on the opposite side, to the breadth of three-fourths of a mile, but afterwards expands to the width of five or six miles. The name Quebec denotes in the Algonquin language this contraction. The basin, which is the name given to the wide part of the river before the town, is capable of floating 100 ships of the line.

Quebec is divided into the Upper and Lower towns. The former stands upon limestone rock on the side of Cape Diamond; and the lower town, which is built close to the river and round the bottom of the point, or ground gained from the sea, is 15 feet lower than the upper one, and is separated from it by a line of steep rocks.

The streets of Quebec are, from the nature of its situation, very uneven and irregular. All of them are well paved, and their breadths vary from 24 to 32 feet. St Louis Street is reckoned the finest part of the town, and contains many handsome houses of modern aspect. The greater proportion of the houses in Quebec are built with stone.

Among the public buildings of Quebec the castle of St. Louis is the principle one. It is a handsome stone edifice, standing on the summit of the rock, and on the margin of a precipice about 200 feet high. From the gallery which surrounds the solid wall of masonry which supports the building, there is an extensive view of great interest. The castle is three stories in height, and is 162 feet in length, and 45 in breadth.

The court-house, which is 136 feet long, and 44 broad, is a large modern building of stone, situated in St. Louis Street. The cathedral of the Protestant church, though simple in its ornaments, is deemed one of the handsomest edifices in the city. It is 136 feet long and 75 broad, and stands near the court-house. Its spire, which is high, is covered with tin, like several of the houses. The cathedral of the Catholics, which is opposite to the market-place, is a spacious and massy building of stone, about 216 feet long and 108 broad. The new jail, which is an elegant edifice of fine freestone, about 160 feet long and 68 broad, cost £15,000, and was completed in 1814. In the artillery barracks, which are a new building, about 527 feet long and 40 broad, there is an armoury, store-houses, and work shops, besides quarters for the artillery soldiers. The armoury contains small arms, &c. for 20,000 men, which are always ready for use. The Ursuline convent is a good building, and its church is richly and beautifully ornamented. Besides these buildings, there is the Scots church, the Lower town church, the seminary, the union hotel built in 1808, near the castle, and the hospital general one of the largest of the houses which is in the suburbs without the walls.

The fortifications of Quebec have been long celebrated for their strength. Towards the river, nature has given it ample protection, and where the rock is accessible, very slight walls form a sufficient defence. The principal battery, which commands the bason, is mounted with twenty-two 24 pounders, and two French 36 pounders, and two large iron mortars. This battery is flanked by another of six guns, which commands the passes from the Lower town. From the great battery proceeds a line of defences past the Hope and Palace gates, and joining the Coteau du Palais.

The principal exports from Quebec are grain, flour, timber, lumber, ashes, &c. and the imports consist of all the articles manufactured in Europe. The annual value of the exports and imports is calculated at about one million sterling.

The climate of Quebec is intensely cold, especially in the winter. The mean temperature is so low as 41°.74 Fahrenheit. The mean temperature of summer is 68°, and that of winter 14° 18. The river is not always frozen over; but in winter large masses of ice floating up and down with the tide, considerably impede the navigation.

The scenery exhibited from various parts of the Upper town of Quebec, is represented by Mr. Weld, as surpassing in grandeur, beauty, and diversity, any thing that he has seen either in America, or in any other part of the globe.

The population of Quebec has been recently estimated at 18,000. West Long. 71° 5′ 29″, and North Lat. 46° 48′ 38″. See America, Vol. II. p. 658; and Canada, Vol. V. p. 320. Weld's *Travels in Canada*, vol. i.; Gray's *Account of Canada*, &c.; and Marshall's *Life of Washington*, vol. i. &c.

QUEDA. See Malacca, Vol. XIII. p. 293, col. 2.

QUEENBOROUGH, is a borough town of England, in the island of Sheppey and county of Kent. It consists of about 200 new houses, all of which are exactly two stories high. A new guild hall has been lately erected on the site of the old market house, and the market place and jail are below it. The church, though old, is neatly fitted up. The inhabitants are chiefly employed in the oyster fishery. The town is governed by a mayor, four jurats, and two bailiffs, and sends to parliament two members, who are elected by 150 voters. Population about 805.

QUEEN Charlotte's Island, is an island in the Pacific, discovered in 1767 by Captain Wallis. It is about six miles long and one broad, sandy and level, and full of trees. The inhabitants are of a middle size and dark complexion. Their dress was a kind of coarse matting. West Long. 138° 4′. South Lat. 19° 18′.

QUEEN Charlotte's Islands, is the name of a group of islands discovered by Captain Carteret in 1767, and consisting of Egmont's Island, or New Guernsey, Lord Howe's Island, or New Jersey, and some others. Mendana first discovered these islands in 1595, and called the principal one Santa Cruz. These islands are in general fertile and inhabited. E. Long. 163° 30′ to 165° 10′. S. Lat. 9° 50′ to 11° 20′. See Hawkesworth's *Voyages*, vol. i. p. 349.

QUEEN Charlotte's Island. See Zealand, New.

Queen's County.

QUEEN'S County, is the name of a county in Ireland, which derives its name from Queen Mary, in whose reign it was established. For the same reason its chief town was called Maryborough. This county is bounded by King's County on the north and west, by Kildare and part of Carlow on the east; by Kilkenny on the south, and by Tipperary on the south-west. Its form is that of a parallelogram, having one of its sides thirty-two English miles, and the other twenty-five miles long. It contains about 590 square English miles and 378,023 English acres. It has eight baronies and fifty parishes; and in 1821, a population of about 129,391 inhabitants, being an increase of 15,574 since 1813.

The principal hills of the county are the mountains of Sliebh-bloom, and the Dysart hills. The former are so steep and impassable, that for fourteen miles where they separate the King's and Queen's Counties, there is only one pass through them, and that a very difficult one, called the Gap of Glandine. The rivers Barrow and Nore have their source in this Ridge. The Dysart hills form a detached part, and command a view of a fine country, ornamented with plantations and magnificent demesnes. The rest of the county is rather flat, and the whole is watered with rivers and numerous mountain streams. According to Sir Charles Coote, the following is the ratio of the different kinds of land, in Irish acres.

Arable land, pasture and meadow,	210,000
Bog, mountain and waste,	21,000
Roads,	2,000
Woods and plantations,	1,300
Water,	1,000
	235,3000

In the map belonging to the Grand Jury, the bogs and mountains are reckoned at 60,000.

Queen's county is watered with some rivers, and by many mountain streams. Of these, the Barrow and the Nore, which rise among the mountains in the west, are the principal. The Barrow flows in a north-east direction by Portarlington to Monastereven, and thence in a south-east direction to Carlow, where it forms the boundary between Queen's county and that of Kildare. It is navigable throughout from Portarlington, in the neighbourhood of which it widens its bed, and winds through enclosures of fertile banks. From Athy, on the Barrow, there is a canal to Dublin. The Nore, though deep and long, is not navigable; but it might, without much difficulty, be rendered so, by levelling the numerous weirs. It has a south-easterly course to Kilkenny; and after the junction of the Rose and Barrow, near New Ross, it is navigable for large ships to the sea.

The soil of the county is various, from a very stiff clay to a sandy loam. There is also a good deal of strong gravelly soil, well adapted to the cultivation of corn. "The soil of the Sliebh-bloom mountains is variable, the surface inclining to a black and alternately yellow stiff clay, of unequal depths, covering a loose rotten rock, or a gritty gravel, with occasionally a little appearance of limestone. The western side more generally inclines to a strong red clay, not unlike the nature of the soil in some of the northern counties in Ireland, where oats and potatoes only are sown; but it generally is throughout spungy, wet and boggy to the summit, and very rocky."

The general fuel, excepting near Carlow, is bog. The depth of the bogs is various; but the best is in general only a few spades below the surface. A shal-

Queen's County, Queensferry.

low bog of about two spades deep, occurs in the moors over a stratum of gravel or clay. When this is reclaimed, it forms the richest land, and the expense is frequently repaid in one year.

According to Sir Charles Coote, the principal minerals in Queen's County are, limestone, coal, iron, copper, manganese, mica, marble, freestone, ochre, marle, Fuller's earth, and a variety of clays valuable in pottery. Rich quarries of limestone exist in almost every town land. The coal is the same as that of Kilkenny, or glance coal of Werner. It occurs near Carlow, where the collieries are very extensive. The quantity of timber in this county is very small, in consequence of the tenants having been partly obliged to cut, burn, and destroy so many acres of wood.

The principal towns in Queen's County are, Maryborough, Portarlington, Stradbelly, Mountmelich, Mountrath, and Ballynekill. Maryborough, which is the county town, was disfranchised along with Ballynekill, at the Union. Portarlington, which sends one member to Parliament, is a populous and well-built town, of one street, on the Barrow. Many genteel families resort to it for the sake of its schools, which are numerous. Stradbelly is a neat village, with a handsome church, a good market place, and a charter school. A monastery was founded there in the 12th century by Lord O'More.

The principal manufactures of the county are linens and coarse woollen goods. The principal exports are corn and other articles of land produce. A good deal of cheese is made for the Dublin market.

Queen's County sends two members to Parliament.

A great part of Queen's County is divided into large estates, from L.5000 to L.15,000 per annum, some of which are let on perpetual leases. The chief proprietors are, the Marquis of Drogheda, Lord de Vesci, Ossory, Ashbrooke, Stanhope, Castle Coote, Portarlington, and Maryborough; Sir Charles Coote, Mr. Parnell, Mr. Strange.

See Beaufort's *Memoir of a Map of Ireland.* Sir Charles Coote's *Statistical Survey of Queens County;* and Wakefield's *Statistical Account of Ireland.*

QUEENSFERRY, SOUTH, a royal burgh and seaport town of Scotland in the county of Linlithgow, is situated on the south side of the Firth of Forth, about 9 miles from Edinburgh, and on the great north road. It consists principally of an irregular street, composed of ill-built houses, and a few of which are of decent aspect. There are, on the west side of the town, the remains of an old chapel, with a stone roof.

Queensferry derives its chief importance from the ferry which is at Newhalls, about a quarter of a mile to the east of the town. This ferry has long been under excellent management. Good piers of solid masonry project into the sea, so that there is a passage at all times of the tide. The south pier, which is double, is particularly excellent; and there is a light and watch house erected on a rock at the north pier. There are also sundry piers on the south side, one to the west of the town, and another to the east of Newhalls.

The passage is only about two miles wide; and half way through there is a rock with a small fort on its summit.

The town, which sends a member to Parliament in conjunction with Stirling, Dunfermline, Inverkeithing, and Culross, is governed by a provost, one land bailie, two sea bailies, a dean of guild, and a town-council. In old charters, the town is called *Passagium Reginæ,* in honour of Margaret, Malcolm Canmore's queen, who frequented and patronised the place.

The principal manufacture of the town is brown soap; and the place is sustained chiefly by it and by the fishery, and the business of the ferry.

The Firth at this place was surveyed several years ago, with the view of cutting a tunnel beneath it; but the enterprise was then deemed too hazardous, and has not been revived even in this period of speculation.

Hopetoun House, the magnificent mansion of the Earl of Hopetoun, is partly situated on the top of the ridge which rises from the shore to the west of the town.

The great road from Edinburgh to the ferry has recently (in 1824) been greatly improved, by an elegant bridge over Cramond water; and as the road passes by the fine and picturesque grounds of Dalmeny park, the residence of the Earl of Roseberry, and commands occasionally fine views of the Forth, the stage between Edinburgh and Queenferry is perhaps one of the finest in the kingdom. Population about 560.

North Queensferry consists of an inn and a few houses, on the north side of the Firth, and exports whinstone from the extensive quarries in its vicinity.

QUELPAERT is the name of an island in the eastern seas, situated to the south of Corea, in east Long. 126° 18′ 57″, and north Lat. 33° 7′ 49″. The Sparrow Hawk, a Dutch vessel, was wrecked here in 1635; and La Perouse coasted along it in 1787. The middle of the island rises into a peak above 5000 feet high, which is seen at the distance of 18 or 20 leagues; and the land slopes gradually to the sea. The island appears to be well cultivated to a considerable height.

QUERCITRON is the name given to the bark of the *Quercus Tinctoria.*

This tree is one of the largest of the American trees; and generally attains its greatest size in the valleys between the high mountains of North Carolina. Its height is commonly 80 feet, and its diameter 8 feet. It is highly valuable for its timber, and its bark is reckoned superior in tanning to any other species of oak, in consequence of the yellow colour which it gives to the leather.

It was introduced into dying under the name of Quercitron by Dr. Bancroft, whose method and processes are fully detailed in our article DYEING, vol. viii. sect. 33, 142, 150, 260, 316, 328, 335, 338, 379.

QUERCUS. See BOTANY, and MATERIA MEDICA, Vol. XIII. p. 352.

QUESNAY FRANCOIS, a celebrated physician and political economist, was born at Ecquivilly, or as some say, at Merey, in 1694, and was the son of a common labourer, or a small farmer. His education was entirely neglected; and he is said to have learned to read the *Maison Rustique* of Liebaut, by means of a few lessons from the village gardener; and by the aid of his master, the surgeon of Ecquivilly, he acquired a knowledge of the Latin and Greek languages. The assistance thus given to our young student was amply repaid; for when his master applied for admission to the college of St. Come, he presented several essays, written by Queenay, which were received with high applause. This little incident roused the ambition of Queenay, and excited him to repair to Paris, where he prosecuted most ardently his medical studies, and began also his metaphysical researches by the perusal of Malebranche's *Recherche de la Vérité.* At this time an accidental acquaintance with Cochin, of the Royal Academy, induced him to acquire from that artist a know-

Quesnay François || Quintilian Marcus Fabius.

ledge of drawing and surgery, which he found of great use in his professional pursuits.

Having completed his studies at Paris, he settled at Nantes, a town of considerable magnitude, in his native province; but from some low jealousy of his talents, the corporation of surgeons refused to admit him into their body. He accordingly returned to Paris, and having passed his examinations in the most successful manner, he was ordered to be admitted into the corporation at Nantes in 1718.

The reputation which he acquired in this town, recommended him particularly to the Duke de Villeroy, whose family he attended; and he was induced to accompany his Grace to Paris in 1730, as his family surgeon.

An event of a very accidental nature happened to him at this time, which laid the foundation of his future success in life. Having called at the Countess D'Estrade's along with the Duke, Quesnay remained n the carriage. During the visit, the Countess was eized with an epileptic fit, so that Quesnay was instantly summoned into the house, and perceiving the ature of the disease, which had scarcely begun, he rdered the Duke and the other attendants out of the oom, and contrived to conceal the nature of the malady. Grateful for the kindness and skill of Quesnay, he Countess recommended him to Madame Pompaour, who made him her family physician, and procurd him in 1737 the situation of surgeon in ordinary to he King.

Having written a refutation of the doctrines of Silva, especting blood-letting, he exhibited such zeal and nowledge in a public controversy in which this involved him, that M. Peyronie got him appointed secreary to the academy of surgery, which he had succeedd in establishing in 1731. For the memoirs of this cademy, he wrote the preface to the first volume, and any articles on particular branches of surgery, which ave always been much admired. The labours of this ffice having begun to injure his health, which had been elicate from repeated attacks of the gout, he wished to uit the arduous duties of a surgeon, and he accordngly took his degree of M.D. in 1744, and was soon fter appointed consulting physician to his majesty, in hich capacity he attended his royal master in the mpaigns of 1744 and 1745. Amid the bustle and istractions of a military life, he collected the materials f his *Traité des Fievres continues*, which appeared in 753, in 2 vols. 12mo.

After the Dauphin had undergone the small-pox, e King presented him with letters of nobility; and om the confidence which he always placed in the dgment of our author, in consequence of which he alled him *son penseur*, he gave him three *pensées* flowers r his arms, with the motto of *Propter cogitationem mentis.*

The good fortune of Quesnay had now placed him n circumstances of comparative ease and affluence, and e seems to have employed his leisure in republishing me of his medical works, and in completing those hich he had planned. He republished, in 1747, an nlarged edition, in 3 vols., of his *Essai Physique sur Economie Animale*, which first appeared in 1736, and hich, in the opinion of Haller, is more characterized by ypothesis than by sound practical views. In 1748 appeared his *Examen Impartiel des Contestations des Mecins et des Chirurgiens de Paris.* In 1749 he pubshed, in 4to., his *Mémoire Presenté au Roi, par son remier Chirurgien, ou l'on examine la sagesse de l'ancienne Legislation, sur l'état de la Chirurgie en France.* n the same year appeared his *Traité de la Suppuration,* in 12mo., and his *Traité de la Gangrène*, the last of which is still held in the highest esteem. In 1744 he published his *Recherches Critiques et Historiques sur l'Origine, sur les divers états, et sur le Progrès de la Chirurgie en France*, a work which called forth some opposition in relation to the alleged inaccuracy of the historical statements.

After the publication of his Treatise on Fevers in 1753, Quesnay seems to have directed himself principally to the study of political economy. He contributed the articles *Fermier* and *Grains* to the volume of the Encyclopædia, which appeared in 1756 and 1757. His *Tableau Economique* was printed at Versailles in 1758, with the *Maximes Générales de Gouvernement Economique* annexed to it. Although the author had been much afflicted by the gout, yet his mental faculties remained unimpaired. At the end of his life he occupied himself with the study of mathematics. He died at Versailles in December 1774, in the 80th year of his age. An account of the territorial system of Quesnay will be found in our article POLITICAL ECONOMY, in this Volume, p. 39, 40; and farther particulars respecting him will be found in his Eloge, in the Memoirs of the Academy for 1774; Eloy's *Diction. Historique de la Médicine*; the Count D'Albon's Eloge, in the *Ephémérides du Citoyen*, for 1775; Marmontel's *Memoirs*; and Chalmers' *Biographical Dictionary*, vol. xxv.

QUICKSILVER. See MERCURY, in CHEMISTRY and MINERALOGY Indexes.

QUILLOTA. See CHILI, Vol. VI. p. 192, &c.

QUILOA, a city and sea-port town of Africa, and capital of a kingdom of the same name. It is situated on the east coast, near the mouth of the river Coavo, and was discovered in 1498 by the Portuguese. The town is built on an island, and is said to be large and rich, the houses being built of stone and mortar, after the Spanish fashion, and ornamented with terraces and gardens. The streets are so narrow, that one may easily step from one side to the other. The citadel, which was the residence of the Mahometan sovereigns, is surrounded with a ditch and fortification, and adorned with stately towers.

This place was visited in 1812 by Captain Beaver, who saw only a number of scattered huts, and found that the export of slaves had diminished from 10,000 to a few hundreds. The Imam of Muscat, who wrested this place from the Portuguese, maintains a fort with three guns and half a dozen soldiers, who keep in tributary subjection the King of Quiloa. East long. 39° 47', and south lat. 8° 40'.

QUIMPER, a town of France, and chief place of the department of Finisterre, is situated on the Oder, which is navigable for ships of 200 tons to the sea. It is divided into the old and new town, and encircled with a wall and towers. The principal buildings are the cathedral, the exchange, the public library, and the botanical garden. It is principally supported by its fisheries, and manufactures of stone-ware. Population, 6608.

QUINTILIAN MARCUS FABIUS, a celebrated teacher of eloquence, was born in Spain about the year of our Lord 42, and was educated at Rome, where he studied eloquence under the celebrated orator Domitius Afer. He opened a school of rhetoric at Rome, and had the honour of being the first person who received a salary from the state as a public teacher. This laborious duty he discharged for 20 years with great approbation and success, at the same time that he carried on his profession as a pleader at the bar. With the permission of the Emperor Domitian, he retired to

Quintilian Marcus Fabius, Quintin, St.

enjoy the fruits of his industry, and devoted himself with great assiduity to the study of literature. He wrote a Treatise on the Causes of the Corruption of Eloquence; and, at the urgent request of several of his friends, he composed his *Institutiones Oratoriae*, which contains a complete system of oratory, and which were discovered in 1415, in an old tower of a monastery at St. Gall, by Poggio Bracciolini of Florence. It is divided into 12 books, in which he points out the kind of education suited to an orator from his infancy.

Quintilian was appointed preceptor to the two young princes whom Domitian intended to make his successors; but the pleasure which he derived from the favour of the Emperor, and the success of his works, was sadly imbittered by the death of his wife and his two sons, one of whom he has described as a prodigy of premature talent. Quintilian died about A.D. 95. The best editions of Quintilian are those of Gesner, Gotting. 1738, 4to.; of Lug. Batav. 1665, cum notis variorum; and that of Gibson, Oxon. 1693.

QUINTIN, St. is a town of France, in the department of the Aisne. It stands on the river Somme, on the canals of Crozat and St. Quintin. The streets, which are numerous, are tolerably wide, clean, and regular, and many of the houses good and well built. The market place is square. On one side of it is the Hotel de Ville, and in the middle is a well with an elegant iron rail and framing. The cathedral is a huge mass of building, without either towers or spires, and rising high above all the other houses in the town. It is plain, and rather ugly on the outside, with a very steep roof. The portal at the west end is very heavy, with a mixture of Greek architecture. The cathedral has, what is unusual, two transepts, which give great variety and richness to the interior. In consequence of this, the breadth of the whole of the choir, including the aisles, &c. is the breadth or length of the transept. The sculptures between the pillars of the choir, and seen from behind, have been much defaced. In one of the little chapels on the right hand of the altar there are some fine paintings and tapestry, and the painted glass in the windows, particularly in those of the choir, is very grand. A noble iron grate and railing separates the choir from the nave. The north window of the great transept is very grand, and there is a fine circular *vitrage* in the north end of the little transept. The south window of it is not circular, but is very grandly painted. The lowest window in the little transept is covered with vitrages, composed of very large figures.

The *Halle aux Bled*, near the market place, has a high turret, and has formerly been a church.

The Maison de Ville is a singular piece of Gothic architecture, situated on the north side of the market place. It is two stories high, and has an arcade below of seven pointed arches. On the second story there are *nine* gothic windows. This is surmounted with an ornamented ballustrade, and the front terminates with three pediments, each of which is nearly an equilateral triangle. On the middle pediment a clock has been placed. There is a foundling hospital in the town, which is a plain brick building. The country around St. Quintin is in general bare. Though rich, the soil is red and clayey, and there are great numbers of windmills in the vicinity.

This town has long been celebrated for its manufactures of thread, linen, cambric, lawn, gauze, and cotton; and it carries on a great export trade with France, Holland, Germany, &c. The population of the town is about 11,000. The number of houses is above 1800.

A full account of the magnificent canal of St Quintin, will be found in our article on Inland Navigation, Vol. XV. p. 227.

QUINTUS Curtius Rufus, a Latin historian, celebrated by his History of the reign of Alexander the Great, is supposed to have flourished in the reign of Vespasian or Trajan. His work, which has been admired for the elegance and purity of his style, is divided into ten books; of which the first and second, the end of the fifth, and the beginning of the sixth, are lost. An elaborate supplement to this work has been written by Freinshemius. The best editions are those of Elzevir, Amsterdam, 1673, 8vo.; of Snakenburg, Lugd. Bat. 1724; and of Barbou, Paris, 1757.

QUITO, the name of an extensive province of South America, is bounded on the north by that of Santa Fe de Bogota, on the west by the Pacific, on the south by Peru, and on the east by the Portuguese territories. It is about 600 miles long from north to south, and about 1800 broad. The population however is chiefly confined to the valley between the two Cordilleras of the Andes, which resembles a street when compared with the whole extent of the country, which, especially in the eastern governments, is thinly scattered with missionary villages.

The productions of Quito are extremely various, owing to the variety of climate and of elevation which it enjoys. The level and champaign districts produce harvests of Indian corn in great abundance, while the bottoms of deep cavities, enjoying a still warmer temperature, are planted with sugar canes, from which great quantities of sugar and rum are obtained. The lands near the summits of the mountains, possessing various temperatures, produce wheat, barley, potatoes, and pot-herbs of all kinds. Above these plantations on the mountain plains, are fed numerous flocks of sheep, the wool of which affords employment to a great number of people. Some of the farmers rear cows for the purpose of making butter and cheese, while others breed cattle, and at the same time manufacture cloth, baizes, and serges.

Although the climate varies very rapidly in this country, and though in the course of half a day we may pass from the heat of the torrid to the cold of the frigid zone, yet in the same place vicissitudes seldom occur. This equability of the climate in the same place, joined to the great fertility of the soil, occasions a regular succession of the productions of the earth. No sooner are the fruits matured, and the leaves begin to change their colour, than fresh leaves, blossoms, and fruits appear on the same tree in their proper gradations; and as the same happens with regard to corn, the operations of sowing and reaping are carried on at the same time. The corn and fruits are here particularly excellent; and the beef, veal, mutton, pork, and poultry, are remarkably delicate and fine.

The principal manufactures of Quito are cottons, some of which are white, called Tucuyos, and others striped, baizes and cloths, which find a ready market at Lima. The interior provinces of Peru are thus supplied with them in return for silver, gold, silver fringes, wine, brandy, oil, copper, tin, lead, and quicksilver. The agricultural productions of Quito, are chiefly consumed within the province, with the exception of the wheat, a part of which is sent to Guayquil. The quantity of cheese annually consumed within the province, is calculated at between seventy and eighty thousand dollars of the money of the country. Goods manufactured by the public, or woven by private Indians, are sent, together with some kinds of provisions, to the jurisdiction of Barbacoas. These provisions are exchanged for the gold found in the country, which is disposed of in Lima at a greater price. The stuffs of Quito find a market in the governments of Popayan and Santa Fe. Indigo in very great quantities is brought into the province from the coast of New Spain, and by way of Guayaquil iron and steel are imported both from Europe and the coast of Guatimala.

In our articles on the ANDES, Vol. II. p. 47, and PHYSICAL GEOGRAPHY, Vol. XVI. p. 486, 491, &c. &c. will be found much curious information respecting this province. See Ulloa's *Voyage*, vol. iv.; Alcedo's *Dictionary*; and Humboldt's *Personal Narrative*.

QUITO, the capital of the province of Quito in South America, is built on the acclivity of the volcanic mountain of Pinchincha, and also among the ravines formed by the eminences of this mountain; so that the streets are extremely uneven and irregular; and many of the houses founded on arches. In point of magnitude, Quito is ranked among the cities of the second order in Europe.

The principal regular streets of Quito are four in number, which terminate at the angles of the principal square. They are straight, broad, and handsome, and are paved. At the distance of three or four hundred yards the irregular streets commence, and they are so steep that the inhabitants are deprived of the use of coaches or wheel carriages. Some of the streets are intersected by ravines or breaches, and the houses are built on the sides of their rugged projections. The principal square is very spacious, and has an elegant fountain in its centre. On one side of the square stands the cathedral, on the opposite side is the episcopal palace. The town house occupies the third side, and the palace of the audience the fourth. Besides this square, there are two others of spacious dimensions, and several of a smaller size. Most of the convents are situated in these squares, and some of them, particularly that of the Franciscans, are elegant and ornamental structures. The principal houses are large, spacious, and well laid out. They are only one story high, with low and narrow doors and windows. They are built of *adobes*, or unburnt bricks and clay, cemented by *canguaga*, an uncommonly hard kind of mortar, employed by the ancient Indians.

The city of Quito, which was erected into a bishopric in 1545, contains seven parish churches, a university, a cathedral, an hospital, with numerous convents, nunneries, &c. The cathedral, endowed in 1545, has an extensive jurisdiction, and the bishop's revenue is 24,000 piastres. It is richly adorned with tapestry hangings, and very expensive monuments; but the parish churches are buildings of mean appearance. The college of the Jesuits, and the convents of the Augustins, Dominicans, and Fathers of Mercy, are large, well-built, and highly ornamented buildings. In the church of the Jesuits there is a slab of alabaster, on which is commemorated in Latin the labours of the French and Spanish mathematicians from 1736 to 1742, and containing many particulars respecting the measurement of a degree of the meridian which was then taken on the plain of Quito. The hospital is a fine building, with separate wards for men and women, under the patronage of the order of our Lady of Bethlehem.

Quito.

The principal courts are that of the royal audience, the exchequer or chamber of finances, and a treasury for receiving the effects of persons deceased. The corporation consists of a corregidor, two ordinary alcaides, elected annually, and regidores.

The population of Quito, including all ranks, is estimated at 70,000, though Alcedo makes it only 58,000. The higher ranks are either the descendants of the original conquerors, or of those who afterwards came over from Spain invested with some lucrative office. The lower classes consist of Spaniards or whites, Mestizos, Indians or natives, and negroes. The Spaniards, according to Ulloa, amount to one sixth part of the population. The Mestizos, the progeny of Spaniards and Indians, form nearly one third, and the Indians form another third. The others, who amount to about one third, form the casts. The Spaniards are too proud to be industrious, and are therefore generally poor. The Mestizos are occupied in different trades, but chiefly in the higher arts, such as painting and sculpture, in which they excel. The Indians are generally occupied with the lower professions, such as that of shoemakers, bricklayers, weavers, &c. The women are more numerous than the men, and old age begins in the men at about thirty.

Quito is situated at the height of 9538 feet above the level of the sea, and there rises behind it the conical summit of the Javirac, immediately below that of Pinchincha. Several streams from the sides of the mountains supply the city with water by means of conduits, and several of those streams, which unite at one point, form the river Mangora, over which there is a stone bridge. The mean temperature of Quito is 57°. 92 of Fahrenheit. The maximum temperature is 71°. 6, and the minimum 42.8°. The temperature of the day varies from 60.08° to 66.74°; and that of the night from 48°. 2 to 51°. 8. An account of the earthquake which desolated Quito in 1797, and of the climate, will be found in our article ANDES, Vol. II. p. 50. col. 2. p. 51. col. 1. p. 54. col. 2.

See Ulloa's *Voyage*, vol. i. book v. chap. iv. &c.; Humboldt's *Personal Narrative*, and his *Memoir on Isothermal Lines*, in the *Mémoires d'Arcueil*, tome iii. p. 462.

R.

RAAB, a town of Hungary, and capital of the county of Raab or Gyori Varmegye. It is situated in an agreeable level country, at the conflux of the Danube, the Raab, and the Rabnitz, by which it is nearly surrounded. Several of the streets are regular, straight, and spacious. Most of the houses are built of stone, and some of them are very handsome. The great square is ornamented with fine buildings, among which the ci-devant college of the Jesuits is particularly admired. The principal establishments here are the academy, erected in 1750, where lectures in philosophy, theology, and law are delivered; and the college of the Lutherans. The cathedral is a superb building, and its choir cost 70,000 florins. The castle and the fortifica-

Raab.

Raasay.

tions of the city were constructed by Ferdinand I. and Maximilian II. Both nature and art have contributed to defend it. There is a large glacis and open space between the town and the suburbs. The fortifications consist of seven bastions, and there is always here a strong garrison of soldiers, provided with military stores. Knives and swords, and some other articles of cutlery, are the principal manufactures of the place. Population about 13,000. East long. 17° 6′ 45″; north lat. 47° 41′ 15″.

RAASAY, or Raaza, from *Raa*, a roe in Danish, one of the Western Islands of Scotland, in the parish of Portree, and county of Inverness. It is situated between the Mainland and the Isle of Sky, from which it is divided by a channel from one to three miles wide. The island is about fifteen miles long, and from one to three in breadth, and contains about 31½ square miles. On all its sides the coast rises to a great height above the sea, forming as it were a single ridge above 1,000 feet high; but, on the east, it is peculiarly bold and precipitous. The island is mountainous throughout, and towards its south end, it rises into a lofty hill called Dunn-Cann, about 1500 feet high, which gives rise to many streams, and at the base of which are two fresh water lakes. The soil is principally peat-earth, sand, or gravel, and is better fitted for pasturage than for tillage, though there are several spots of fertile and well-cultivated land. The supply of freestone in Raasay is almost inexhaustible. There is also plenty of limestone; and near one of the limestone quarries there is a calcareous petrifying spring. Gneiss occupies the whole of the northern extremity of the island, and is the lowest substance. The red sandstone begins where the gneiss ends, and the porphyry, which is incumbent on the sandstone, is limited to the western side of the southern division, or to that part immediately opposite to Sky. Dr. MacCulloch discovered the prehnite in the island.

Among the antiquities of the island, the principal are the remains of two forts, the highest of which, situated in the south extremity of the island, is called Dunn-Cann, a name supposed to be derived from Caune, cousin to one of the Danish kings. The other fort, at the north end of the island, and on the east coast, called Castle Brochel, is a landmark well known to sailors. It stands on a conglomerate rock almost round, and having an area of about seventy feet square, the mass of rock resembling an excrescence projecting from a cone. The rock is forty feet high, except where the stair leads up to it; and it is sixty feet above the level of the sea at its base. "This building," says Dr. MacCulloch, "is so contrived, as to cover the whole summit of the sharp eminence on which it stands; its walls being continuous with the precipitous pieces of the rock. The projections of these have been so contrived as to form parts of the building; and they are at the same time so like in appearance to the masonry of which it is constructed, that it is often difficult to distinguish between the artificial and the natural wall. The castle, which is a whimsical and picturesque structure, is built of stone and lime, and was formerly the chief seat of Macleod of Raasay. The seat of the family, however, is now at Clachan or Kirktown, near the opposite end of the island. The island abounds with roe deer, which destroy the young plantations. There are remains of woods in various parts of Raasay, and some beautiful and stately trees near Clachan. The population of Raasay, together with the adjacent island of Ronay, is about 1000. West long. about 6°; north lat. 57° 25′.

For farther information respecting this island, see Macdonald's *Agricultural Survey of the Hebrides*. Edin. 1811, p. 774—779; and Dr. MacCulloch's *Description of the Western Islands*, vol. i. p. 239—259, in which work there is a fine engraving of Brochel Castle.

RABELAIS, Francis, a celebrated French satirist, was born, according to some, about the year 1483, and, according to others, in 1490, at Chinon in Touraine. He entered early among the Cordeliers, and acquired considerable popularity as a preacher; but, in consequence of some scandal in the monastery, he was imprisoned in his cloister. He is said, however, to have obtained his liberation from his wit and facetiousness, and to have been permitted by the Pope to remove to the Order of St. Benedict. His habits of life induced him to lay aside his religious character in 1530, and to repair to Montpellier, for the purpose of studying physic. When the Chancellor Du Pratt abolished the privileges of the faculty of medicine at Montpellier, by a decree of parliament, Rabelais is said to have had the address to make him get the decree revoked; and in commemoration of this event, bachelors in the medical school of Montpellier are invested with a scarlet robe, which is said to be the very robe worn by Rabelais.

After continuing some time at Montpellier, he went to Lyons, where he published a collection of some pieces of Hippocrates and Galen, and likewise several other works, among which were some of the books of his *History of Gargantua and Pantagruel*, which gave him such a high rank among the writers of burlesque. Having resided in the same convent with Cardinal John du Bellay, now archbishop of Paris, Rabelais waited upon him in Paris in 1535; and such was the impression which his talents and wit made upon the prelate, that he took him into his family as physician, librarian, and steward. In 1536, Du Bellay went to Rome as ambassador from the French court; and Rabelais made himself so agreeable to the Pope and the cardinals, that he not only received absolution for the crime of apostacy, but obtained a privilege to enable him to hold ecclesiastical benefices. Having taken his degree of Doctor of Medicine at Montpellier in 1539, he soon after returned to Paris, and by the interest of the archbishop, he was received as a secular canon in the abbey of St. Maur near Paris. He was afterwards appointed to the curacy of Meudon, the duties of which he discharged from 1545 till the time of his death, which took place in 1553, in the 70th or 63d year of his age.

The principal work of Rabelais is his *History of Gargantua and Pantagruel*, already mentioned. It is a general satire upon popes, priests, and monks, and upon follies and knaveries of various kinds, which it would not have been prudent to expose gravely. This work brought down upon him the hostility of the monks, who procured its condemnation by the Sorbonne and the parliament; but this event only added to the popularity of Rabelais, and made his company much more courted by the wits of Paris. This work is characterised by wit, learning, obscenity, and ribaldry.

A complete edition of his works was published in Holland in 5 vols. 8vo. in 1715, with notes by Duchat; and another at Amsterdam in 3 vols. 4to. in 1741, with plates by Picart.

RABBIT. See Mazology, Vol. XIII. p. 443.

RACINE, John, a celebrated French poet, was born at Ferre Milon, in 1639. Racine received his education at the convent of Port-Royal, in the neighbourhood of Paris; and after studying philosophy at the college of Harcourt, he began his career as an author, by publishing an Ode on the King's Marriage, which, more successful than the first efforts of poets generally are, procured him, through the interest of Colbert, a small pension. Although his uncle, who was a prior, offered to resign to him his benefice, on condition that he would take holy orders, yet he declined this act of liberality; and, elated with the success of his first poetical efforts, he resolved to take up his residence in Paris as an author.

In 1664, he brought upon the stage his first tragedy, entitled, *La Thébaïde, ou les Frères Ennemis,* written injudiciously after the manner of Corneille. He next published his *Alexandre,* and then his *Andromaque,* which established his reputation as a writer of tragedy.

About this time Racine was presented to the priory of Epinay; but as he had not taken orders, his right to hold the living was contested; and, after a law-suit, he was obliged to abandon it.

Racine's success in tragedy induced him to try his powers as a comedian; and he accordingly produced his comedy of *Les Plaideurs,* which, though it met with the approbation of Moliere, and was well received by those about court, was the only one which he published. His *Britannicus, Berenice, Bajazet, Mithridates, Iphigénie,* and *Phædre,* appeared in succession between the years 1670 and 1678, and gained for the author a high degree of popularity and fame.

Having reached this high elevation, he became the object of the malignity and envy of the dull crowd whom he had outstripped by his talents. A mind like his ought to have learned from the history of letters that the hostility of inferior rivals is the first and most sincere tribute that is paid to living genius; but his sensibility was too great to allow himself to be influenced by such views; and he is said to have confessed to a friend, that the worst critique upon his works gave him more pain than the greatest plaudits had given him pleasure.

In this frame of mind, and under the influence of the religious principles which he had early imbibed, he resolved, when he was scarcely thirty-eight years of age, to renounce poetry and plays, and become a Carthusian. His religious adviser, however, advised him to act with more moderation, and his resolution to become Carthusian was converted into the more rational one of taking a wife, and settling quietly in the world. He accordingly married the daughter of a gentleman who was treasurer of Amiens, by whom he had seven children.

In 1673 Racine was admitted a member of the French Academy, in the room of La Motte le Vayer; but he is said to have destroyed the effect of his admission speech by pronouncing it with too much humility. About this time Racine obtained the situation of gentleman in ordinary to the king, to whom he made himself very useful.

In 1677 he was nominated along with Boileau to the office of historiographer royal, with the view of writing the history of Louis XIV. The public expectations were raised by that appointment; but the two poets laboured in vain at their task till they found that it was unsuitable to their genius.

Madam Maintenon, with whom he lived in great intimacy, prevailed upon our author to compose a scriptural dramatic piece, entitled *Esther,* for the ladies of her foundation of St. Cyr, which they performed before the whole court with great applause in 1689. This was followed by his *Athalie,* which the same ladies performed in 1691.

At the request of Madam Maintenon, Racine was ordered to draw up a memorial on the miseries of the people, and the means of relieving them. The king happening to obtain a reading of this memoir from a lady to whom it had been lent, took offence at the manner in which the author had treated the subject. "Because he knows how to write good verses," said the king, "does he suppose that he knows every thing; and would he be a minister of state because he is a great poet?' These expressions, complimentary though they be, are said to have produced a deep effect upon the mind of Racine, and to have brought on a fever, of which he died, on the 22d April, 1699, in the 60th year of his age. The king, who entertained a real affection for the poet, sent often to inquire after him during his illness, and after his death he settled a handsome pension upon his family.

As a dramatic writer, Racine is placed next to Corneille; and he is supposed to have possessed the art of versification to a degree superior to any French author. His plays are characterised by correctness, tenderness, elegance, good taste, and refined and elevated sentiments. Besides his dramatic works, he wrote the *Cantiques,* a work full of devotion; *L'Histoire de Port-Royal, Idylle sur la Paix, Epigrams, Letters,* &c. As Director of the French Academy, he pronounced the eulogy of Corneille. The best edition of his works is that in 6 vols. 8vo. published in 1761.

RACINE, Louis, the son of John Racine, was born at Paris in 1692, and inherited his father's poetical talents as well as his pious dispositions. He adopted the ecclesiastical habit, and in a state of retirement he wrote in 1720 his *Poems on Religion and Grace.* The Cardinal Fleury afterwards gave him a place in the Finance, and he then married and lived happily in his family, till the death of an only son threw him into a state of deep dejection. On the crucifix which he always carried with him, he piously inserted the lines of Tibullus:

> Te spectem suprema mihi cum venerit hora,
> Te teneam moriens deficiente manu.

He died in 1763, at the age of seventy-one. His other writings are *Odes; Epistles; a Translation of Milton's Paradise Lost; Réflexions sur la Poësie; Mémoires sur la Vie de Jean Racine; Remarques sur les Tragédies de Jean Racine.* He likewise wrote several papers in the memoirs of the Academy of Inscriptions, of which he was a member. His works have been published in 6 vols. 12mo.

RADNOR, the name of a county in South Wales, bounded on the north by the counties of Montgomery and Salop; on the west by the counties of Cardigan and Brecknock; on the south by Brecknock; and on the east by Herefordshire and Salop. It is about 20 miles broad from east to west, and about 24 long from north to south. Its area, according to Mr. Clarke, is about 510 square miles, or 346,000 acres; but others compute it at only 426 square miles.

About two-thirds of the whole county is either lying waste, or in a state of commonage. A large mountainous tract in the middle of the county, and partly belonging to the crown, is called the Forest, though it has no trees. The general aspect of the county is bleak and mountainous, particularly in the north-western part. In the east and south, however, the county is more fertile; and the hills, which are here of moderate elevation, are not altogether destitute of wood. The highest ground in Radnorshire is 2163 feet above the sea; and in this region, about two miles west from Radnor, is the waterfall called "Water Break its Neck," Radnorshire.

which descends through a height of 150 feet,* but which is grand only in the time of floods.

The valleys of the county, especially those of Wyeside and Radnor, afford a considerable extent of meadow and arable land, and have a good soil and a corresponding climate. The western mountains consist chiefly of primary slate, and in the valleys between them and the forest, there is a retentive substratum of clay. A decomposing slate rock, with a portion of lime, occurs in the forest and the other inferior hills, and a fertile loamy soil, upon an absorbing gravel, covers the valleys to the coast.

Radnorshire has been gradually improving in its agricultural condition. About 1-5th of the county is under the plough, and 1-10th meadow, and upon which irrigation is produced to some extent. Lime is yielded in great plenty by a quarry near Old Radnor. The greater number of farms are laid out with one half in arable, and the other half in grass lands. The Hereford breed of cattle prevails in the more fertile parts of the county.

The principal rivers in Radnorshire are the Wye, which enters that county at Savan-y-coed, and runs southward till it separates it from Brecknockshire. The Teme flows through the east of the county, past Ludlow, into the Severn; and the Lug and the Aro flow through the middle of the county into Herefordshire. The Elan, the Ithan, the Eddow, and the Mackwy, flow into the Wye. There are a few small lakes in the county, but they are of little importance.

The chief manufactures in Radnorshire are those of flannels and coarse woollen cloths; but in general the wool of the county is sold to the manufacturers of the North, by whom the inhabitants are furnished with cloth in return. Cattle, sheep, horses, and butter, and samples of grain, are carried to the English markets. A lead mine, formerly wrought, has been abandoned. No iron mineral springs exist; but the chief ones which are saline, sulphureous, and chalybeate, is at Llanrindod, which is resorted to by invalids.

The principal object of antiquity in the county is Offa's Dyke, which commencing near Hay at the river Wye, skirts Radnor and Herefordshire, and enters Montgomeryshire at Pwll-y-Pyod. The only religious house was the abbey of Cwm Hir, founded for the Cistertian monks in 1143. It was spoiled by Owen Glendower; but a considerable portion of it still stands in ruins. The remains of a Roman station are still seen at Cwm, near Llanrindod. The Roman road passed close to the base of the hill on which Old Radnor stands. A few fragments of the walls of Radnor Castle still remain; but the entrenchments are entire. The green court yard is nearly in its original form. In different parts of the county, particularly on the top of Gwastedin hill, there are numerous cairns.

Radnorshire contains six hundreds, and 52 parishes, 47 of which are in the diocese of St. David's, and five in that of Hereford. The principal towns are Presteigne, a flourishing place with a population of 1387; Knighton, a handsome and well-built town on the river Teme, with 221 houses and 785 inhabitants; Rhayda, a neat thriving town with a population of about 500; and New Radnor, the subject of the following article. Presteigne is now the county town.

This county sends two members to Parliament. The population in 1821 was 22,503, of whom 11,300 were males, and 11,203 females. The sum charged to the property tax, in 1811, under the heads of rent of land and tithes, was L.97,623.

See Camden's *Britannia*; the *Beauties of England and Wales*, vol. xviii. p. 874: Skrine's *Tours in Wales*; Pennant's *Tour in Wales*; Barber's *Tour through South Wales*; Malkins' *Scenery, Antiquities, and Biography of South Wales*, vol. i. p. 407; and Clark's *General View of the Agriculture of the County of Radnor*, 4to.

RADNOR NEW, or MAES-YFED, a borough and market town of South Wales, in the county of Radnor, is situated near the river Somergill, at the mouth of a pass between two hills. Though a town at one time of considerable importance, it consists now only of a few poor looking houses grouped into an irregular street. The public buildings are the town-hall, the prison, and the church. The church has a hall, or south aisle, and chancel, with a tower at the west end. The town was formerly defended by a strong wall and a deep moat, some remains of which are still visible. Its castle was a majestic pile, situated upon a neighbouring eminence, but only a small part of it remains. The corporation consists of a bailiff, 25 capital burgesses, two aldermen, a recorder, and other officers. Radnor joins with the other contiguous boroughs in sending a member to parliament. The number of voters is above 300. Population about 80 houses and 400 inhabitants.

See Carlisle's *Topographical Dictionary of Wales*, and the works quoted in the preceding article.

RAEBURN, SIR HENRY, the most celebrated portrait painter that Scotland ever produced, was born on the 4th March, 1756, and was the son of Mr. William Raeburn, a respectable manufacturer at Stockbridge, one of the suburbs of Edinburgh. Although he had the misfortune to lose both his parents when a child, yet his elder brother William, who succeeded to his father's business, took the charge of his education, which naturally devolved upon him.

Sir Henry's propensity to drawing was observed only in his striking superiority to the other boys in delineating figures on the slate, at the class of arithmetic; but this does not seem to have influenced him in the choice of a profession, or to have excited any expectations on the part of his friends.

At the age of fifteen, he was bound apprentice to an eminent goldsmith in Edinburgh, and it was in this situation that his taste and passion for painting were first developed. He first amused himself with painting miniatures, without having either seen a picture, or received any instructions in the art. These miniatures were executed in such a superior manner, as to excite the attention of his friends; and, with the view of encouraging the young artist, his master took him to see the pictures of David Martin, with which he was delighted and astonished.

Mr. Raeburn now continued to paint miniatures, which came into general demand; but as this new employment interfered with his duties as an apprentice, an arrangement was made, by which his master received a proportion of his earnings, and dispensed with his attendance.

Having now acquired some experience in this art, Mr. Raeburn began to paint in oil, and on a large scale; and he was assisted in this task by the kindness of Martin, who lent him several pictures to copy, but who gave him no other kind of aid. In this manner he was gradually led to give up miniature painting, and as soon as his apprenticeship had expired, became professionally a portrait painter.

In 1778, Mr. Raeburn married a daughter of Peter Edgar, Esq. of Bridgelands, with whom he received some fortune; but in place of settling himself quietly in Edinburgh, this change in his circumstances seems to have increased his desire of excelling in his profession.

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* Other accounts state its height at only 70 feet.

With the view of improving in his art, he repaired to London, and introduced himself and his works to the notice of Sir Joshua Reynolds. From that great man Mr. Raeburn met with the kindest reception. He recommended a residence in Italy, as likely to enlarge his ideas and promote his improvement, and he even offered, had it been required, to supply the funds for that purpose. In obedience to this advice, Mr. Raeburn set out for Rome, with introductory letters from Sir Joshua to the most eminent artists and men of science in that capital. After spending two years in Italy, diligently engaged in studying those great works of art with which that country abounds, he returned in 1787, and established himself in Edinburgh. Having taken apartments in George Street, he found himself at once in the possession of full employment; and David Martin, who perceived the popularity and success of his rival, speedily retired from business. Mr. Raeburn was, therefore, now placed at the head of his profession in Scotland, an eminence which no artist presumed to dispute with him during the remainder of his life.

In the year 1795, Mr. Raeburn built a large house in York Place, the upper part of which he lighted from the roof, and fitted up as an extensive gallery, while the rest of the house was laid out in convenient painting rooms. He constantly resided at St. Bernard's, near Stockbridge, a house which he had neatly fitted up, on the banks of the Water of Leith, which has here a picturesque appearance. Contiguous to his paternal residence there, he purchased some fields on its north bank, which he has feued out on perpetual leases, on a judicious and tasteful plan, and which, from some recent improvements executed by his son, particularly a new stone bridge, promises to be the most extensive, as it is the most beautiful suburb of our fine city.

The future history of Mr. Raeburn's life is limited to that of the paintings which he executed. Having studied exclusively the works of the Italian masters, and having been neither in the habit of seeing the works of his contemporaries nor the English collections of old pictures, he maintained an elevation and dignity of style peculiarly his own. His likenesses were, with a very few exceptions, universally regarded as most striking ones. They were always the most favourable that could be taken, and are highly characteristic of the mind and pursuits of the individual. His equestrian statues obtained for him a high degree of reputation, not only from his success in painting horses, but from the skilful manner in which he combined them with the human figure. His principal portraits of this kind are those of his own son upon a pony, of Sir David Baird, of the Duke of Hamilton, of the Earl of Hopetoun, and of Lord Kintore's gamekeeper.

Among the early pictures of Mr. Raeburn may be enumerated those of Sir John and Lady Clerk, at Penicuick, which were executed soon after his return from Italy; his portrait of Mr. John Clerk, now Lord Eldin; and that of the late Principal Hill. Among his full length portraits, executed during the last fifteen years, may be enumerated those of Sir Walter Scott, the late Mr. Keith of Ravelstone, Mr. Dugald Stewart, the late Professor Playfair, the late Francis Horner, M. P. the late Lord Frederick Campbell, Glengarry, the late Macnab, the late Mr. Macdonald of St. Martins, Sir John Hay, Bart. Lord Glenlee, Lord Douglas, Dr. Hope, Sir John Douglas, &c. &c.

Among his pictures of a smaller size which have been admired are those of Lady Cuming Gordon, Mr. and Mrs. Skene of Rubislaw, Mrs. Hay, Mr. Thomas Thomson, Mr. John Murray, the celebrated James Watt, and the late Dr. Marcet.

To this list of some of the best of Mr. Raeburn's pictures, we shall subjoin the following general observations on his style of painting, which we believe are from the pen of the Rev. Mr. Thomson of Duddingston.

"Of Sir Henry Raeburn's pictures it may be said, that few, perhaps none of them, exhibit that attention to finishing, which invites close and minute inspection. At an early period of his career he began to paint for effect, and he seems to have judged that labour unnecessary which was not to tell in the general result of his works, as viewed at a certain distance from the spectator. In the works of Vandyke, this minuteness of finish and delicate expression of all the smaller parts has been happily combined with a mastery and power over the general effect, which, while it takes nothing away from their vigour, as seen on the walls of the gallery, renders them interesting and delightful as subjects of near inspection and careful analysis. To those who are curious to know how far this latter quality may be sacrificed without prejudice to the former, the pictures of Sir Henry will afford a school of very interesting instruction: nor is that discernment and dexterity to be ranked of ordinary attainment, which can at once see and at once express all that is effective and essential, so as to exhibit at the distance from which it is intended to be seen, the full result of the highest and most careful finishing. All who are conversant with the practice of the art must have observed how often the spirit which gave life and vigour to a first sketch has gradually evaporated as the picture advanced to its more finished state. To preserve this spirit, combined with the evanescent delicacies and blendings, which appear on minute inspection, constitutes a perfection in art to which few have attained. And if the works of Sir H. fail to exhibit this rare combination, to this distinction they will always have a just claim, that they possess a freedom, a vigour, and spirit of effect, conveying an impression of grace, and life, and reality, which we look for in vain amidst thousands of pictures, both ancient and modern, of more elaborate execution and pains-taking finish."

Though Mr. Raeburn devoted himself with unceasing assiduity to the labours of his profession, yet he found leisure for cultivating his mind by general reading, and had acquired very considerable information on many subjects that were but little connected with the object of his profession. He was passionately fond of mechanics and hydrodynamics; and though he had not acquired that knowledge of geometry and analysis which is requisite to the profound study of these branches of knowledge, yet he had obtained a practical acquaintance with them, which is not often possessed by the general reader.

Mr. Raeburn had also paid some attention to the kindred art of sculpture; and such was his passion for it, that when he was at Rome, he conceived the design of making it his profession. The principal attempt which, in so far as we know, he made in sculpture, was a small medallion of himself, executed after his return from Rome; and it is impossible to see this piece of art without being convinced that Mr. Raeburn would have stood as high as a sculptor as he now does as a painter.

Mr. Raeburn was elected a Fellow of the Royal Society of Edinburgh, and a Member of the Imperial Academy of Florence, of the Academy of New York, and of the Academy of South Carolina. In 1814, when his first picture was sent to the Royal Academy of London, he was elected an Associate, and in the succeeding year he was appointed an Academician. In the year 1822, when king George IV. honoured Scotland with a visit, the dignity of knighthood was without any solicitation conferred on Mr. Raeburn, as the head of our resident school of painting. This honour was conferred upon Sir Henry Raeburn in the great saloon at Hopetoun House, with the sword of Sir Alexander Hope, and before a large party who had assembled in that magnificent mansion to celebrate the last day of our sovereign's visit to Scotland.

On the occasion of this respect being shown to Sir Henry, the other artists of our metropolis, with a liberality which did them the highest honour, gave a public dinner to Sir Henry on the 5th of October, for the purpose of testifying the satisfaction which they felt at the choice made by his Majesty. In the summer of 1823, Sir Henry received the appointment of Portrait Painter to his Majesty for Scotland; but the nomination was not announced to him till the very day on which he was attacked with his last illness.

Sir Henry continued to labour at his profession in the latter part of his life with the same zeal and industry as in his most active years; and the pictures executed during the last two or three years of his life, some of which we have already enumerated, were equal to any that he ever painted.

The most interesting, however, of Sir Henry's recent works, are a series of half-length portraits of his literary and scientific friends, which he painted solely for his own private gratification. Among these are the portraits of Sir Walter Scott, Mr. Jeffrey, Mr. F. Horner, the Rev. A. Alison, Dr. Brewster, the Rev. Andrew Thomson, the late Mr. Rennie, Mr. Cockburn, the Rev. J. Thomson, and Mr. H. W. Williams. The portrait of the Rev. Dr. A. Thomson is, in our opinion, the best of this group, and one of the best that he ever painted.

Sir Henry had now reached that period of life when even the most active mind begins to think with some seriousness of the change which awaits it. Though in perfect health, and of a frame which seemed to defy the ordinary contingencies of time and disease, we have often heard him allude to the probability of that change. In the summer of 1823 he went upon an excursion into Fifeshire with Sir Walter Scott, the Lord Chief Baron Shepherd, William Clerk, Esq. and a small party of friends, under the auspices of Lord Chief Commissioner Adam, (the early and steady friend of Sir Henry Raeburn,) who have for some years paid an annual visit to objects of historical curiosity and interest. On that occasion his health seemed to be eminently vigorous, and he contributed his full share to the hilarity of the party. When he returned to Edinburgh, Sir Walter Scott sat to him for the half-length portrait above mentioned, and for another for Lord Montague. These pictures were the last which he painted; and in a few days after they were finished, Sir Henry was seized with a general debility, which was not attended with any visible disease. This unexpected attack continued for a week to baffle all the skill of his medical attendants, and carried him off on the 8th July, 1823, in the 68th year of his age.

The loss of this great artist was deeply felt, not only by his personal friends, but by the public at large. Those who took a deep interest in the progress of the fine arts in Scotland, saw that the place of Sir Henry Raeburn could not be supplied; and those who considered the art of painting as administering only to their luxury—to the luxury of their vanity or their sorrow—were deprived of one of the highest sources of gratification.

The Royal Institution for the Encouragement of the Fine Arts in Scotland, held a meeting on the 10th of July, at which they passed resolutions of regret and condolence on the loss of their eminent colleague, and particularly lamented that the season of the year, and other circumstances, prevented them from requesting permission of his family to attend publicly, in a body, his remains to the grave.

At a meeting of the Royal Academy of London, on the 16th of July, Sir Thomas Lawrence lamented the melancholy task which had devolved upon him, of announcing officially to his colleagues the death of one of their most distinguished associates. "He expressed his high admiration for the talents of the deceased, and his unfeigned respect for the high feeling and gentlemanlike conduct which had conferred a dignity on himself, and on the art which he professed. His loss, Sir Thomas conceived, had left a blank in the Royal Academy, as well as in his own country, which could not be filled up."

By Lady Raeburn, who still survives him, Sir Henry had two sons, the eldest of whom, inheriting his father's talent, died at the early age of nineteen. His second son, Mr. Henry Raeburn, who is married and has a family, lived always under the same roof with his father.

Sir Henry Raeburn was no less elevated above the ordinary level of men of genius by his religious and moral character, than he was by his skill as an artist. That overweening vanity, the weed which grows so rankly under the influence of public applause, and which so often intoxicates and corrupts the painter and the poet, had never taken root in the mind of Sir Henry. The praise which was so liberally bestowed on his works served only to make him more humble, and to nourish those grave virtues which marked his character. He was a regular and habitual attender upon the public duties of religion; a Christian in heart as well as in practice. In the bosom of his family, and of that of his son, he spent the happiest hours of his life, and took particular pleasure in the society and playful sports of the young. To young men of promising talent he was ever ready to afford assistance and advice; towards the labours of his brother artists his candour was proverbial; and if the term error could ever be associated with any act of his, it could only be in those cases where a little severe and decided criticism may be regarded as truer kindness, than that mild and gentle praise which often pushes the dull pretender into a sphere far above his own.

Sir Henry has left behind him a good portrait of himself, from which an engraving is now executing by Mr. Walker of Edinburgh. There is an engraving of Sir Henry by Mr. Nicholson, and a bust by Mr. Campbell, a promising Scotish sculptor now residing at Rome; but none of them are characteristic likenesses. We trust, however, that the genius of Mr. Joseph will supply this defect in the bust of Sir Henry, with which he is at present occupied.

RAFAEL. See Raphael.

RAGUSA, anciently Ragusium, the chief town of a district of the same name in Austrian Dalmatia. It is situated on the Adriatic, in a peninsula, which forms an excellent harbour, sheltered by a hill from the impetuosity of the north winds. Ragusa is concealed by a wall flanked with towers, now in a state of decay; but some modern defences of considerable strength have been erected at the harbour. The streets of this town

Ragusa.

are generally narrow. The principal public buildings are the Hotel de Ville, where the chief magistrate resides, the cathedral, and some of the churches. The see of Ragusa is archiepiscopal with six suffragans. The principal manufactures of the town are silk and cotton stuffs, and some ships are occasionally built. The Ragusians have many country houses at Gravosa, another seaport town. Milet, or Melida, is the chief of the little isles subject to Ragusa, and it is fertile in oranges, lemons, and good wine. The circumjacent islands are highly beautified both by nature and art. An earthquake which happened here, in 1677, destroyed nearly 6000 souls. Population about 10,000. E. long. 18° 11′ 55″; S. lat. 42° 36′ 30″.

RAILWAY.

Railway.

By the term Railway is understood a road formed by laying distinct tracks of timber, iron, or stone, for wheel carriages. In the construction of railways, stone is more particularly applicable to common roads, and the use of timber is now almost laid aside, while iron is very generally employed.

When we consider the great proportion of labour which is unavoidably spent in the carriage of the necessaries and conveniences of civilized life in all its varied forms, we at once see the importance of every measure tending to facilitate and improve commercial intercourse. All are aware of the benefit which Great Britain has derived from her inland navigation; such, however, are the difficulties and expence of canal operations, that another substitute for the common road has long been sought after by the public. The attention of the engineer has accordingly been of late much directed to the construction of railways; a mode of communication which will be found more simple and economical in all its details than the canal. Perhaps this cannot be better shown than by a general comparison of the work performed under similar circumstances, by both modes of traffic. Independently of the difficulties so often experienced in procuring a full and regular supply of water, the expence of a canal, calculated for boats of about thirty tons burden, may, at a rough estimate, be taken at the rate of from L.6000 to L.9000 per mile; while a railway with two sets of iron tracks, capable of working with three tons, may be estimated at from L.3000 to L.5000 per mile. These sums might respectively be quoted in a still greater disproportion in favour of the railway system; but we deem it sufficient in this place to say, that, in similar situations, it will in no case exceed one-half the expence of the navigable canal. In contrasting the utility of these modes of conveyance, we may assume, that the great object aimed at in both is to avoid the effects of friction on the undulating line of draught of the common road. When a more perfect system of interior communication came first to be sought after, it was extremely natural to have recourse to the deepening of rivers, and afterwards to the artificial canal; a *roadway*, if we may be allowed the expression, which is equally removed from the asperities of the highway, and the adverse currents of the river. The canal has, notwithstanding, the disadvantages of a resisting medium to contend with, acting against the draught in the inverse ratio of the velocity of the boat.

The speed of canal carriage must always be limited by the destruction which rapid motion occasions to the banks. In this respect railways have great advantages over canals; for where the rails are strong, and the waggons light, the rapidity of conveyance may be conceived to keep pace with the impelling power of steam. The value of the economy of *time* is measured and proved by the vast exertions used, and sums expended in Britain to accommodate the public, and the ample harvest reaped by those who best fulfil its wishes in this respect. In this commercial country the economy of *time* and *power* is felt to be the same thing; and the numerous carriages established in England to convey goods at *speed*, shows that the value of rapid conveyance is not confined to passengers alone. From the obstacles above mentioned, then, however managed or improved, we can never much increase the present rate of motion on canals, which must ever form a slow mode of conveyance, independently of its other disadvantages.

The facility with which temporary railways may be laid for short distances from manufactories, granaries, and other works, to communicate with great public lines of railway in their neighbourhood, is another advantage belonging to the railway system; for the expence of a canal branch would, in almost all cases, be much greater than any temporary or private object could repay; while branch railways would, when in general use, become readily saleable after the local object was obtained, and the principal expence incurred would, in many situations, be merely that of laying and forming them into a road. When branch railways are connected with canals, much labour is lost in loading and unloading, besides damage occasioned by these operations to the articles conveyed. Canals capable of floating sea-borne vessels must always afford great facilities to commerce, and promote the improvement of the districts through which they pass; but it may be doubted whether, from the limits to a supply of water in almost all situations, and the impossibility of procuring it in many, their great original cost, damage to adjoining lands, and interruption to the communications of property on their opposite banks, are not objections of a paramount nature, which lead us to conclude that they cannot compete with railways in convenience, economy, and remuneration for the capital embarked in their construction. The general introduction of steam vessels in the coasting trade will render many of the present *ship canals* less useful in proportion as their breadth and size of locks are incapable of receiving steam vessels constructed for the open sea. Railways, again, will benefit by every improvement in the use of the steam engine, may be used in all situations where any mode of conveyance is possible, and in practice give about double the dispatch of canal conveyance, without increasing the working power. Indeed, the anticipation of a speedy adoption and general use of steam conveyance on railways of iron and stone, would seem at present far more natural, and likely to be soon realised, than was imagined but a very few years ago, owing to the projected revolution now going on by the use of steam in the coasting trade.

Under all circumstances, it is found that a horse works only with about three times the load upon a canal that he does upon a well-constructed level railway, which is now sought after as the highest improvement of which the interior communication of a country is susceptibe. In proof of this, we further notice that one person is sufficient to conduct the horse-load upon a railway, while three individuals are generally required for the same purpose upon a canal. We may also mention, that inland navigation is subject to interruption by the frosts of winter and the droughts of summer. The comparative facility of loading and discharging are likewise much in favour of the traffic on a railway; while nearly the same proportion of labour in the trackage of empty or return boats and waggons is incident to both. Without calculating upon the immense loads, extending to fifty tons, which have been tracked by the steam waggon, or of thirty tons and upwards, which have occasionally been moved by one horse upon a level railway, we can state that an active horse, weighing ten cwt. conducted by only one man, upon a well-constructed level edge railway, will work with ten tons of goods. In the same manner we may take thirty tons as employing the effective labour of one horse and three persons upon a canal; from which it will therefore appear, that the expence of trackage per ton is pretty much the same in both systems, while the first cost, and consequently the toll or dues, must be greatly in favour of the railway. For very weighty and bulky goods, the canal is allowed to be more suitable; yet, in practice, many of such articles may be so placed as to bear upon the wheels of more than one waggon on a railway. Upon the whole, we are of opinion, that in every case it is better to construct a railway than a small canal, excepting where the union of similar works is to be effected. The case is different where it is intended to transport *sea-borne ships* across a country, from shore to shore, as on the Forth and Clyde, the Crinan and the Caledonian canals in Scotland.

Origin of railways.

In treating this subject, it may be proper to give some short account of the introduction and progress of the railway system. There can be no doubt that it is of British origin; and being still in a great measure peculiar to this country, it has not unaptly been termed the "British Roadway." Wooden railways seem first to have been known in Northumberland, particularly in the neighbourhood of Newcastle, and that probably as far back as the sixteenth century; but we believe it was reserved for Mr. William Reynolds of Coalbrookdale, in Shropshire, about the year 1767, first to put the crude material of roads into the crucible of the refiner, and thus introduce the use of rails wholly of iron. Rails of this description were soon afterwards applied, by a Mr. Curr, to the *under-ground works* of the Duke of Norfolk's collieries near Sheffield. The first public railway company is understood to have been instituted at Loughborough, in the year 1789, where the late eminent Mr. Jessop had the merit of first employing the edge-rail. About ten years afterwards, Mr. Benjamin Outram introduced the plate-rail, with props of stone at the joinings of the rails instead of timber. Hitherto both the edge and plate-rails were made of cast iron, but, in the year 1811, the former was, we believe, first made wholly of malleable iron at Lord Carlisle's coalworks in Cumberland. Stone tracks in large blocks, laid in the form of what may be termed rails, are of great antiquity, as appears from the construction of some of the famous Roman ways still to be seen at Rome, and in other cities of Italy. An attempt is now making to introduce these tracks on streets and common roads, the stones of which are not much larger than those of the best aisler causeway, formed and laid after a particular manner, suggested by Mr. Stevenson, engineer.

In noticing the progress of railways, it would now be difficult even to enumerate the various works of this description which have been executed throughout the United Kingdom, as railways are universally employed at all the principal coal and iron works, in situations altogether inaccessible to a communication by water. In not a few instances they have been constructed by joint stock companies, and sometimes by individuals as public thoroughfares.

The only public railway of extent in Scotland, is that between the manufacturing town of Kilmarnock and the harbour of Troon; which, agreeably to act of Parliament, is open to all upon payment of a certain toll. This extensive work, like those of the Duke of Bridgewater's in England, was executed at the sole expence of the Duke of Portland, for the improvement of his Ayrshire estates. The Troon railway is about ten miles in length, and is laid with two sets of cast-iron tracks, of the description technically termed plate-rails. It crosses the river Irvine by a stone bridge of four arches, each of forty feet span, and the whole line forms an inclined plane, falling towards the shipping port, at the rate of about one-sixteenth of an inch perpendicular to one yard horizontal. In its track it encounters a difficult pass through Shaulton moss; and towards the harbour, the uniform line of draught is preserved by an embankment of about two miles in length. This work, with the great pier founded in about eighteen feet water in the lowest tides, together with the graving-docks and whole establishment at Troon, were executed agreeably to a design of the late Mr. Jessop's, and, with the *coal fittings* in the neighbourhood, are understood to have cost about L.150,000. The other railways in Scotland which may be mentioned as of extent or interest, are those of the Carron Company, the establishment of which are understood to have reduced the average monthly expenditure for carriage from L.1200 to L.300, the coal works of the Earls of Elgin and Mar in Fife and Clackmannan shires, Sir John Hope of Pinkie, Mr. Wauchope of Edmondstone, and Mr. Cadell of Cockenzie, in Mid-Lothian; Mr. Dickson, and others in Lanarkshire; and Mr. Taylor and others in Ayrshire. These are edge-railways, and such of them as have lately been laid, are chiefly of malleable iron.

In England, at all the coal and manufacturing districts, railways are employed for facilitating and economising the operations. In the counties of Northumberland and Durham alone, the coal-workings and railways require a separate map (Aikenhead's map) to show their position. Here the system of *way-leave* was first introduced, a source of revenue in the form of a tonnage, paid to landed proprietors for liberty to pass through their grounds with a line of railway to the shipping port. In Durham, a public railway is now constructing between the coal-works in the neighbourhood of Bishop Aukland, the town of Darlington, and its port of Stockton. In Cumberland, perhaps the most interesting railways are those of the under-ground works of Lord Lonsdale at Whitehaven. In the great manufacturing and commercial county of Lancashire, railways are very numerous; near Preston, the valley of the Ribble is crossed by two inclined planes of considerable extent, along which the waggons are transported by means of stationary or fixed steam engines. A highly interesting work also occurs at the Duke of Bridgewater's under-ground works at Worsley, about seven miles from Manchester. Here the works are so accommodated, that boats containing about ten tons of coal are let down upon an inclined plane fitted with cast-iron plate-rails, measuring eight inches broad, and an inch and a half in thickness, laid with a uniform bearing upon solid rock from one canal to another, the empty boats being at the same time passed upwards. This inclined plane is 150 yards in length, having a declivity at the rate of one perpendicular to four horizontal. In Derby, Stafford, and Warwickshires, railways are numerous, some of which are connected with inclined planes, and are works of considerable extent, as those of Little Eaton and Butterly. At Mansfield, in Nottingham, there is a public railway nine miles in length, which was designed and executed by Mr. Josias Jessop. The labour and materials of this work are understood to have cost about L.22,000; but including compensation for lands, and the erection of wharfs and warehouses, the expence of the whole operation amounted to about L.32,000. In Shropshire, and indeed along the whole course of the Severn, railways have been introduced with the best effects. Those of Coalbrookdale and its neighbourhood, where Reynolds, the famous ironmaster, first introduced the use of cast-iron for railways and bridges, are highly interesting. It was also in this School of Arts upon the great scale that loaded boats were first transported upon inclined planes, between higher and lower lines of canal, by means of steam engines, instead of locking with water in the usual manner. At Cheltenham in Gloucestershire, Loughborough in Leicestershire, and Wandsworth in Surrey, and in other situations, there are public railways varying in extent from seven to twenty-six miles, and differing in their lines of draught, according to the situation of the country.

South Wales, perhaps more than any other country of similar extent, abounds with valuable minerals; which, from the inaccessible nature of the country, must have been in a great measure shut up, but for the introduction of the railway system. Here a large uninhabited district of sterile mountains may be said all at once to have become the seat of populous towns and villages. Such, for example, is Merthyr-tydvil, of which the Marquis of Bute is Lord of the Manor. When the late Mr. Crashey, the great iron master of this district, established himself here about the year 1765, the parish of Merthyr-tydvil contained a very scanty population; but at the census in 1811, it had increased to 11,104 inhabitants; and in that of 1821, it has mounted up to 17,404. The railways of this district are numerous and many of them extensive, particularly in Glamorgan, Monmouth, Caermarthen, and Brecknockshires. Among these may be mentioned the Sirhowy railway, which, with its branches and collateral lines, extends upwards of 35 miles. It crosses the Ebbwy by a bridge of 16 arches, forms a connexion with the Wye, and has had the effect of reducing the price of coal throughout the higher parts of Radnor and Herefordshires. The Cardiff and Merthyr-tydvil railway is about 27 miles in length; and it is worthy of remark, that both a common road and a navigable canal are established between those places. An experiment was made on this line of railway in the year 1801, when one of Trevethic's high pressure-engines was set upon a waggon as a loco-motive engine, when 10 tons of iron, and about 70 persons were drawn along a distance of nine miles. At the great iron works of Merthyr-tydvil, Dowlais, Penydarran, and others in that neighbourhood, much use is made of railways. Here waggons, loaded with minerals, are transported upon an inclined plane upon a horizontal platform by steam, in a very simple and expeditious manner. Connected with the Neath canal, there are several railways with inclined planes of considerable magnitude; and at Swansea, one is laid to the village of Oystermouth, a distance of seven miles; but its usefulness is nearly lost, owing to its vicinity to a blowing drift-sand. On this line, a stage-coach plies daily with passengers, which indeed appears to be its chief trade. In Caermarthenshire, there is a railway to the harbour of Lanelly, which extends about 15 miles into the interior coal country.

In North Wales.

In the mineral districts of North Wales, connected with the shires of Caernarvon, Denbigh, and Merioneth, there are several extensive railway works. That belonging to the slate-quarries of Penrhyn, is about six miles in extent, and is laid out in four successive horizontal tracks, which communicate with each other by means of three inclined planes, varying in length from 130 to 300 yards. On these the work is so arranged, that in passing down the loaded waggons, the empty ones are taken up by a track-rope, which winds round the axle of a *brake-wheel*. On the more level parts of the road, the waggons are drawn by horses. The Penrhyn railway may now be considered a pretty old establishment; and its good condition affords an example of the stability of the edge-railway, having been in (1824) use for seventeen or eighteen years. This neighbourhood we may mention as not less interesting to the engineer, from its public works, including the stupendous bridge now stretching across the Straits of Menai, the slate-quarries of Penrhyn, and the copper mines of Anglesea, than to the man of taste, for the beauties of its scenery, including the magnificent ruins of the castles of Caernarvon, Beaumaris, and Conway.

In Ireland.

In Ireland there are yet but few railways, excepting those at the Harbour-works of Dublin, and at quarries and other works of that description, which, from their temporary nature, are not generally calculated to afford good specimens of the art; but in the progress of the improvement of that fine country, we may look forward to the period, when such works will be more generally established, and conducted with all the improvement and systematic precision of the sister kingdom.

Surveys of new works.

In connexion with the railways noticed above, we may mention several extensive surveys, which have been made for works of this description. One of these by Mr. Telford, extends across the country from Glasgow to Berwick-upon-Tweed, a distance of 125 miles, with a rise of 636 feet to the water-shade, in the parish of Dolphingstoun. The survey from Berwick to Kelso, by the late eminent Mr. Rennie, has been farther continued up Gala Water to Dalkeith, Edinburgh, and Leith, by Mr. Stevenson, who has also made a survey upon the opposite side of the Frith of Forth, on an uninterrupted level from the river Tay; through the great valley of Strathmore to Aberdeen, with branch-lines to the ports of Stonehaven, Montrose, Arbroath, Dundee, and Perth, comprising upwards of one hundred miles of level road. A collateral line has likewise been traced by the same engineer from the confluence of the rivers Earn and Tay, through the county of Fife to the westward of Dunfermline, with various branch-lines communicating with the Frith of Forth. An extensive survey has lately been made by Mr. James, for connecting Liverpool with Manchester by a railway, notwithstanding the water communications already established between these places by the river Mersey and the Irwell Canal. It may further be mentioned, that after looking forward for many years for a canal across the country between the Tyne and the Solway, (a track of all others most desirable for such a work,) a railway is now contemplated, even by those who were most anxious that this improvement should be a navigable canal. These operations, or certain compartments of them, may be expected ere long to be carried into effect, as the benefits of the railway system are every day more apparent. A public railway is indeed now executing, under the direction of Mr. Granger, between the Forth and Clyde canal, and the extensive coal field in the vicinity of the Monkland canal, near Airdrie.

Construction of railways.

In noticing the construction of railways in this place, we conceive it only to be necessary to describe what may be considered the chief points of the system, leaving minor details, which may now be examined in almost every district of the country, by those who are professional or curious. In pursuance of this view we observe, that every practicable effort should be made, to form the line of draught upon *one level*, or upon a *succession of level reaches*, connected either by inclined planes or perpendicular lifts, according to the circumstances of the ground. The line of direction of a railway is another feature of this measure, which in many instances is too apt to be overlooked. It has been objected to a canal with long reaches in direct lines, that the water is apt to be collected at the further end during high winds, so as to overflow its banks; but as this does not apply to a railway, it ought to be carried as directly as the situation of the country will admit; and wherever a turn becomes unavoidably necessary, it should be formed upon a curve of as large a radius as can be conveniently procured, attention being at the same time paid to lay the inner rail somewhat lower than the outer one, by which part of the friction in bringing round the waggons will be avoided. To show the advantage of the direct line more fully, we observe, that in an up-hill draught, a carriage may be conceived as in the state of being continually lifted by increments proportional to its rise and progress upon the road. In winding about, a similar effect is also produced, as the carriage may be said to be continually brought from a state of rest to that of motion, in a manner perhaps not less detrimental to the effective power of the horse, than the up-hill draught. Though the horizontal or level line is the most desirable, where the traffic is reciprocally carried both ways, yet where the load is all in one direction, a declination towards the point of discharge will naturally be given at such a rate as the situation of the ground will afford, the downward draught being always regulated according to the number and weight of the empty or return-waggons which the horse can draw. Perhaps this will be best accomplished by a fall of four inches to the chain of 22 yards, being at the rate of one perpendicular to 198 horizontal.

Effective power of the horse.

To ascertain the effective power of an active horse, the proper criterion seems to be that of his weight. In the year 1817, the writer of this article made some experiments upon this subject, which he verified by the French instrument called the dynamometer,* applied to trackage upon the Forth and Clyde canal, and also on the Carron Company's railways, when it appeared, that a horse weighing about 10 cwt., in his ordinary working state, exerted a force equal to 160 lb.; and that a force of about 12 lb. was sufficient for the trackage of one ton upon a well-laid level railway. This by calculation, gives 13 tons and 7 cwt. as the work of a horse, which in practice is equal to about 10 tons of goods, exclusive of the waggons. We are, however, aware that 8 or 9 tons in many cases proves full work, when the rails are not laid upon proper principles, or not kept in good order.

Some interesting experiments on this subject have been made, and obligingly communicated to us by Mr. Josias Jessop, son of the late eminent engineer of that name, at his iron works of Butterly, near Derby. That gentleman, whose science and experience give great weight to his opinion, had, upon one occasion, a horse weighing about 10 cwt. yoked to 4½ cwt., or 504 lb., suspended over a pulley in a pit, which the horse drew up with extreme labour, the same weight requiring the united exertion of eleven men. Mr. Jessop is led from observation, to estimate the friction of a well-laid edge railway, to be equal to a rise in the road of about four inches in a chain. He further finds, that upon one of his edge railways, with a rise of 4½ inches to the chain, a horse takes eight tons up-hill, and is never allowed to work with less than six tons: from all which we conclude, that a horse such as we have alluded to, will track 10 tons of goods upon a level railway, exclusively of the weight of the waggons, as daily exemplified in the work done upon the railways at the collieries of the Earl of Elgin, and Sir John Hope of Pinkie. Since, therefore, so much more can be done upon a level than upon an inclined road, it is to be regretted that so little attention is paid to the formation of the former, which gives so decided an advantage, especially to the railway system. It is even not uncommon to hear of a preference being given to an undulating line of road, on the supposition that the horse is more fatigued by a constant draught upon a level road, than by the irregular exertions of an up and down hill journey. This opinion is attempted to be supported by such statements, as that the horse's chest is thereby enlarged, and his wind improved, and that different muscles are brought into action on every change of position. It never seems to be taken into account, that relief is occasionally given by the slow motion up hill, which after all, is not half so beneficial for the animal, as the same slow pace would be upon a level road. Here the postboy generally performs his stage of 12 miles at least half an hour sooner than he would travel the same distance upon a hilly road. Under the article ROADS and Highways, we shall show the fallacy of the doctrine above alluded to, by quoting Dr. Barclay, so eminent in comparative anatomy, and for his scientific knowledge in all that regards muscular motion. These arguments about hilly roads can hardly, however, be said to apply to the railway system, where the power of the horse is understood to be adapted to a uniform strain; and it is upon this principle that we perceive more fully the advantages of a level line of road.

In some situations, the level line of trackage is preserved by the occasional introduction of inclined planes, on which the waggons are transported by machinery from one level to another, impelled generally by steam, water, or animal force. Where the load is all in one direction, as at the collieries of Newcastle, the slate-quarries of Penrhyn, and in many other places, the empty waggons are drawn up inclined planes by the descent of the full ones. This improvement is said to have been first introduced at the Tyrone collieries in Ireland, by Mr. Davis Duckhart, an engineer of the Sardinian service. Notwithstanding the extensive application of the inclined plane to railways, both with and without the use of the steam engine, it still remains a desideratum to obtain some effective mode of lockage or perpendicular lift, which shall be more commodious to the circumstances of an undulating tract of country. Surely, in the present advanced state of things, it cannot prove any serious obstacle to the efforts of professional men, to provide a convenient apparatus, capable of lifting a train of railway waggons *seriatim* on the principle of canal-lockage. In suggesting such a machine, it will perhaps be better to avoid views which may be considered speculative, and apply such as are more or less known in practice. We shall therefore first notice one which we have seen very prettily exemplified upon the small scale in the Lanark cotton-mills, where it is worked by a power taken from one of the water-wheels of these works. This contrivance is employed for conveying the cotton to the hands of the spinners in the upper stories of these extensive mills. A similar apparatus is employed, upon the large scale, by Mr. Baird, at the Shotts iron-works, where the machinery is impelled by a steam engine, of the power of six horses, for raising the minerals from the underground workings. But any power adequate to the purpose may be applied to the lying shaft of this apparatus, which altogether is simple in its structure, and very complete in its operation. In so far as it is applicable to our purpose, we shall term it a *Railway-lock*. It consists of two large cast-iron wheels, placed upon the same axis at a convenient distance from each other, to admit of a railway waggon being suspended between them. Upon the peripheries of these wheels, teeth of a certain description are formed calculated to hook into the continuous links of what is technically termed a *Pitch-chain*. When waggons are to be raised or lowered from one railway to another, the machine is set in motion, and the pitch-chains upon which the waggons are hooked; or by different arrangement of the apparatus they may be placed upon a platform connected with the pitch-chains, and thus moved from one level to another, by the revolution of the machinery, as will be more fully understood from Plate CCCCLXXVII, and its technical description.

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* See the article DYNAMOMETER in this work, vol. VIII. p. 298.

Another machine, suitable for lifts upon a smaller scale, which may also be worked by any convenient power, is described in Stevenson's *Account of the Bell-Rock Lighthouse*, at page 508, under the appellation of a *Sheer-crane*, the machine being represented in Figs. 1. and 2. Plate XI. of that work. The sheer-crane was worked by manual labour at the Bell-Rock, where it was employed for raising blocks of stone out of boats and laying them upon railway waggons; the lift varying from three to seven feet, according to the state of the tide.

In laying out a public railway, a breadth of not less than twenty feet should always be contemplated, so as to admit of two entire sets of tracks, with the necessary sides, paths, and drains. In a private road with one set of tracks, a space of twelve feet in breadth may be found sufficient; but in this case it is generally necessary to make provision for about four passing places in each mile. But this description of road should seldom be resorted to for a public railway, against which the inconveniency of the heavy drag at the turns of the passing places, and the frequent stoppage of the waggons, should prove sufficient objections, especially as the economy in forming and making such a road will not be found great after every thing has been taken into account. It is further of importance to the steady motion of the waggons, particularly in high winds, that they be made rather of a broad and low construction, and that the railway tracks should not be laid at less than four feet apart, which will afford a sufficient tracking-path for the horse, without his being apt to injure the props of the rails. Attention should also be paid to the thorough drainage of the road, that the horse path rests upon a firm bottom, be finished with a smooth and compact surface, and made altogether of the best materials the country through which it passes can afford.

Of cast and malleable iron rails.

In the construction of railway-tracks, timber and cast-iron have hitherto been chiefly employed, but malleable iron is now coming into very general use. The great expence of malleable iron, and perhaps the want of importance formerly attached to railways as a mode of general traffic, were the chief bars to its introduction into the railway system; but, strength for strength, we believe it can always be furnished as cheap as cast-iron. It has sometimes been objected to malleable iron, that it is liable to oxidation or rust, and that it may yield, without its being observable, while the work may thus be continued, under a disadvantageous power, and that it were even better that a rail should break than be thus liable to distortion. These objections, however, appear to be rather of a negative description. With regard to the process of oxidation, it does not seem to carry much weight; as railways of malleable iron may be seen at Lord Carlisle's works at Tynedale-fell, which have been in use for ten years, without appearing to have suffered materially in this respect. The advantages of malleable iron rails are manifest in their not being liable to break, and in diminishing the number of joints. To prevent their yielding in a hurtful manner, it is only necessary somewhat to increase the number of props, and instead of a junction at the distance of every three or four feet, the bars may be extended to twelve or eighteen feet, or might, indeed, by welding, be formed of any length. Upon the whole, therefore, we are inclined to give a decided preference to the use of malleable iron for railway tracks. In the year 1820, the Bedlington iron company of Northumberland were induced to take a patent for certain improvements in the construction of malleable iron rails, suggested to that company, from the perusal of Mr. Stevenson's *Report on the Edinburgh Railway* in 1819, as noticed in the printed remarks attached to their specification. The patentees insist chiefly upon forming the bars of a prismatic figure, and some other particulars, intended to improve their stability. The manner in which these rails are drawn and manufactured is highly creditable to the works at Bedlington; but in recommending malleable iron for railway tracks, we have always had in view the simplest form of the bar with parallel edges. Whether malleable or cast-iron be adopted, the rails should be of the edge form, and be more massive and strong than they commonly are; of the former material for loads of about three tons on a public railway, they should not be less than 30 lb. and the latter 45 lb. per lineal yard, of single rail, and so in proportion, as the weight to be carried is more or less. It is proper, however, to observe, that a little additional weight of metal, in the first instance, in making a substantial apparatus, will in the end prove great economy.

Form of rails.

It is also an important matter to determine the description or form of rails best adapted to the road. These are chiefly of two kinds, the plate and the edge-rail, the former represented in Plate CCCCLXXVII. Figs. 1. and 2. is always made of cast-iron. In Fig. 1. *a b b c* is a plan, and Fig. 2. a section of the Plate rail; with a saddle-piece, *a c*, shown in Fig. 1. which has lately been introduced by Mr. Wilson of Troon, the more effectually to command the joint. The crest or flange *b b*, in Fig. 2. gives strength to the rail, and is intended as a guide to keep the wheel *b d* in its place. From the mode in which the strength is applied in this description of rail, it must evidently require a proportionally greater weight of metal to sustain the same load than the edge-rail represented in Figs. 3. and 4. in which the rail *b c* is set on edge on the principle of joisting in house carpentry. The plate-rail is also liable to be rutted or worn unequally, as will be obvious on examining the action of the wheel *c e d* upon the plate of the rail *a b*, Fig. 2. which, from the situation of the rail, is much exposed to work among dust and small stones, to the great disadvantage of the load, whereas, the wheel *c g h*, Fig. 3. adapted to the edge-rail, is much less exposed to accident from adventitious matters. It has been observed of the wheels of the edge-rail, that the rim *c h* is liable to wear unequally. This is, no doubt, an objection, but the evil does not seem to be remedied by the use of the plate-rail, the surface of which, as before noticed, is apt to be rutted, so that the rails, when worn in this manner, must be lifted and replaced by an operation greater, and ultimately more expensive, than the occasional renewal of a waggon wheel.

Of common carts and railways.

It is believed, that one of the chief advantages originally expected from the use of the plate-rail, was the prospect of employing the cart in common use upon it, as well as the waggon expressly constructed for the railway. This would certainly, in many instances, prove a great conveniency, but in others it would prove a waste of labour. As for example, the horse and man which brought a full load to town, could not accomplish its delivery. The adjustment of the wheels of a carriage, intended for the common road, is also different from that suitable for the railway, so that wherever this has been attempted, it has been found highly prejudicial to the road. It seems, therefore, better, upon the whole, to suppose the traffic to be carried on in waggons specially constructed for the railway. In the delivery of coal and such articles, an arrangement might be made for lifting the body of the waggon upon the wheels of a common cart, and so to be conveyed to the houses of the consumers.

Of laying rails.

To lay rails in a proper manner, so as to prevent their getting loose, and thereby forming an irregular track, it has long been a desideratum to preserve their connected form, and at the same time to provide somewhat for the expansion of the metal. The edge, as well as the plate-rail, is often so injudiciously laid, that the surface of the track is kept too nearly upon a level with the horse-path, and the wheels are thereby continually exposed to work in mud. This earthy stuffing, in many instances, seems to be pertinaciously preserved round the rails, though it cannot be supposed to add in the smallest degree to their stability. It seems therefore much better to keep the rails wholly above the level of the horse-paths without the use of sleepers or cross-bars, a construction which may be termed a *Skeleton railway*. The rails are thereby set above the road, and being completely exposed, additional facilities are afforded for drainage, and repairs. This mode of laying rails has been used with advantage in various situations, particularly at Lord Elgin's extensive lime and coal works. The iron chairs or guides into which the rails are fixed at the joints, and at regular distances between them, generally rest upon blocks or props, marked *a c*, Fig. 1. measuring about eight or ten inches square. In fixing plate-rails, a hole is perforated in the stone prop, and filled with an oaken plug. The ends of the plate *b b* are brought together, and a spike nail, with an elongated countersunk head is driven into the plug, and in this simple, but not very effective manner, the connexion is formed, and the joints kept in their places, to which the addition of the saddle-piece, before noticed as in use at the Troon, has been found a great improvement. In fixing the edge-rails, a great many methods have been adopted, both in the form of the joint and construction of the chair or bed. That represented in Figs. 3. and 4. while it provides for the expansion of the bars, seems to be as effectual and simple as any. Fig. 4. is an elevation of the edge-rail, showing the meeting of the two rails *a b* and *a c* at the point *d*, where a joint is formed and commanded by the chair *a d a*, in which an oblong square hole is formed through which a strong iron spear bolt is driven, as shown in the section *a b c* Fig. 3. These chairs are placed at distances suited to the strength of the rail, and it seems proper that at least three should be allowed to each fathom of rail, every alternate chair to have a spear-bolt, one being always introduced at the joints.

It has lately been proposed by Mr. Palmer, civil engineer, to erect a single rail, supported upon standards of timber, metal, or masonry, according to circumstances. Upon this rail the load is to be contained in a sort of balance waggon, having a receptacle on each side of the rail, on which it is to be suspended on the axles of two wheels, placed the one before the other. In the descriptive account of this railway, Mr. Palmer has given many useful remarks upon railways in general; and discusses the difficulties to which the use of a single track is incident in a very distinct and candid manner. Instead of square blocks of stone for supporting this single rail, he proposes to use stakes of timber or cast-iron, the downward ends of which are to be of a tapering form, and notched in such a manner as to give resistance to the pressure, a prop which, in many situations, may be found convenient and suitable.

Various opinions exist not only about the preferable form of rails, and modes of fixture, but also regarding the weight or load proper to be carried upon them. This was long regulated at the Newcastle collieries, by making the waggon a measure of capacity connected with the duty on the chaldron of coals carried coastwise; when the waggon and its load were made to weigh about four tons. The inconveniences of these ponderous vehicles were for a long period little attended to; especially on the tram or wooden railways, laid with their whole length bearing upon the ground. But when the expense of a metal railway, capable of sustaining such loads, came to be considered, the propriety of using smaller waggons was obvious. Such heavy loads are attended with much inconveniency; they distort the best laid rails by shaking the whole fabric of the road, and ultimately produce much more friction than the introduction of a few additional axles in the use of smaller waggons. When the wheels of such vehicles get off the tracks, it becomes often a work of great difficulty and stoppage to replace them. We are, therefore, of opinion, that a load of from one ton to a ton and a half, independently of the weight of the waggon, should be the maximum upon four wheels. The axles of the waggons should be made straight, and the wheels set at right angles upon them, and care taken that the whole is strong enough, not only for working with a precise weight, but for sustaining the casualties of the road. Railway waggons should not exceed the weight of ten or twelve cwt.; they are generally made of hardwood, and sometimes of plate iron; they ought to be of a square form, with perpendicular sides, rather low and broad, which will make them travel more steadily in stormy weather than when they are high. To carry a ton and a half of coals, for example, they will measure about six feet in length, four feet in breadth, and 1½ foot in depth.

In the formation and superintendence of public railways, it is obvious that considerable attention ought to be given to enforce suitable regulations as to the height and construction of the waggons. In many instances railway waggons may be advantageously hung upon springs. It seems also a simple and economical method to have the body of the waggon, containing the weight, hung on chains, allowing it a natural swing when any irregular motion or unexpected obstacle occurs.

Regarding the size of waggon wheels, and their connection with the axle, various opinions exist. Some have the wheels fixed *dead* upon the axles, like the ancient cars, or those still in use in the Irish cart. Others have both wheels and axles fitted for rotatory motion. But the more general, and we would say preferable mode, is to have the axle fixed and the wheel revolving. On a railway, where obstacles are not supposed to be met with, as on the common road, the wheels are made comparatively small, which affords a rising or favourable line of traction. To determine this point beyond dispute, and also to ascertain the friction upon axles of various dimensions upon the great scale, would resolve an important problem in mechanics. Perhaps a railway wheel of fifteen inches diameter ought to be considered the minimum, and thirty inches the maximum size. These dimensions are favourable to the yoke, and to the purposes of loading and discharging, while to exceed them would add to the weight of the waggon without obtaining much advantage. Waggon wheels are generally made of cast iron. To prevent their wearing unequally, Messrs. Stephenson and Losh, of Newcastle, obtained a patent for hardening the rims of railway wheels.

It has long been a desideratum in the construction of wheels and axles to preserve the *grease* and at the same time exclude the dust of the road. This has, in a great measure, been effected in mail coaches, and other carriages, which travel *at speed*, but has been less attended to in vehicles which move at a slow pace. The consequence is, that upon railways the grease may often be seen dropping with fullness from the linch-pins of one waggon, while the dry axles of another announce its progress upon the road by the most discordant sounds. Mr. Taylor, seeing the disadvantage of this state of things on the railways at his coalworks near Ayr, encouraged his millwright in devising a remedy for this evil, which has at length been effected in a very simple manner, by which he is enabled to have the outward end of the nave of the wheel close, as delineated at letter *e* in Fig. 3. Plate CCCCLXXVII. the common linch-pin, shown at *e*, Fig. 2. being dispensed with. This is effected by means of an appendage fixed to the axle at *d*, Fig. 3. which we shall term a *lever-linch*, the extremity of which at *e* falls into a groove cut on the nave of the wheel marked *e e'*, which keeps it in its place. Letter *f* is a swivel bolt, which keeps the lever-linch *d* and *e'* into the groove *e e'* above alluded to. A model of this apparatus has been presented by Mr. Taylor to the Highland Society; that the person to whom he gives the merit of the invention may meet with some encouragement, and that the public may be put in possession of this improvement. In practice, however, it may perhaps be found that additional trouble will attend the exact adjustment of the wheels to the axle, which, for the prevention of friction both in the socket or bush of the wheel, and in the groove of the new lever-linch, is a matter worthy of due attention.

Of steam waggons for trackage.

In concluding this article, we cannot help remarking that the time is not very remote, when from ten to fifteen cwt. was considered a fair load for an ordinary horse upon the common road. But by recent improvements in the line of draught, and the smoothness of the surface, this load has been at least doubled. Further, by the introduction of the railway system, we now speak confidently of a single horse doing a day's work, upon a level line of edge railway, with as many tons as he formerly did with hundredweights on the common road. Nor is this all; for the Trevethic, or high-pressure-engine, has been mounted upon a railway carriage, and made to drag upwards of fifty tons of coal, exclusively of the weight of the waggons. Where the draught is upon an inclined plane or uphill, a row of cogs or teeth must be laid along the outside of one of the rails, into which a wheel, with corresponding teeth, is made to work, and being impelled by the steam, the engine-waggon gives motion to the whole train. Upon a level road, or when the acclivity is very little, the wheel with teeth is not found necessary, and in that case the power is communicated immediately to the common wheels of the steam-waggon; but in wet weather, when the friction is less, the wheels of the steam-waggon sometimes revolve without dragging its load or moving progressively. This contrivance has now been a good many years known to the public, and has been suggested as applicable to carriages travelling at speed, even upon the common road, but as yet it has not become general in any form. We are, however, happy to see that it is still regarded favourably by the public, and have every reason to hope that time and practice will render it more perfect; being that description of machine which speculation cannot complete, and which practice alone will bring to maturity.

Stone railways.

There are other points connected with the subject of railways, which fall so immediately under the article Roads and Highways, that we shall reserve what farther occurs to us, for insertion under that head, particularly what we have to say upon stone-railways, and cast-iron tracks for ordinary carriages.

Explanation of Plate CCCCLXXVII.

Railway lock. Plate CCCCLXXVII. Figs. 5, 6, 7.

Figures 5, 6, and 7, Plate CCCCLXXVII. are intended to represent a railway-lock, applicable to conveying loads from one level to another, similar to the effect produced by lockage in inland navigation. This is accomplished by the revolution of the wheels alluded to in the foregoing article, over which pitch-chains work on which the waggons are suspended, and so are moved from a lower to a higher level, and *vice versa*. This apparatus may be impelled by the power of steam, water, or animal force, according to circumstances; the axis of the pitch chain wheels being in either case connected with the impelling power, by means of wheel-and-pinion work of strength proportioned to the work. The railway-waggons, as before noticed, may either be set upon a platform fitted to the lock-machine, or they may simply be provided with two strong iron loops attached to their opposite sides; the open parts of which having a downward direction so as to receive the corresponding studs of the pitch-chains. These loops are fixed towards the top of the waggon, that the points of suspension may be as much as possible above the centre of gravity of the load, that it may become more stable when suspended upon the chain. Let us then suppose that a train of waggons has arrived at the bottom of the lock, when the horse is disengaged, and perhaps yoked to a common gin connected with the machinery at the top; the first waggon is then pushed along the railway, till its loop range with the pitch-chains on each side, as shown in Fig. 6. The machinery is now put in motion, and the first pair of studs are hooked into the loops of the waggon, which is immediately suspended, and moved upwards along with the chains. The second waggon is in the same manner pushed forward and attached to the chains, and so of others till the whole are transferred from the one level to the other, as will be understood by examining the diagrams of Plate CCCCLXXVII. Figs. 5, 6, 7. At the top of the lock, Fig. 5 and 7, the waggons marked *g* have just been landed upon the upper railway, while those marked *ffffff*, Figs. 5, 6, and 7, are still attached to the pitch-chains; the upper ones being about to be turned over the axis of the machinery, still preserving their horizontal position, will in their turn be placed upon the projecting ends of the upper rails marked *c c'*. The chains still continuing their revolution, the studs are disengaged from the loops of the waggon, which is thus left upon the upper rail without the assistance of the attendant, who with this apparatus has only to move the waggons to and from the machine. In the same manner a train of waggons is transferred from the higher to the lower level, the machine being worked in the reverse direction, that the studs of the chains may hook the waggons or the platform made to receive them at the top of the lock instead of the bottom. It is also to be noticed, that in the descending load the impelling power requires to be kept in action only till two of the waggons have passed round the pitchwheels, when the application of friction with the common brake becomes necessary to regulate the descent of the load.

Plate CCCCLXXVII. Figs. 5, 6, 7.

In giving a technical description of this machine, Fig. 5, is a plan of a lock, which would of course fall to be excavated in a proper position on the line of road, agreeably to the section of the ground, so as to afford the necessary accommodation for the apparatus. This lock is lined with face-walls of masonry, marked A A A A. The perpendicular rise is here taken at twenty feet. B B is part of the lower railway with the waggons *f* K upon it. C C is the upper level, with a waggon *g g* upon it. *a a a a* show the two wheels over which the pitch-chains pass, and *b* is their axis. C C is a spur wheel on the same axis, with its pinion *d d* mounted on the end of the horizontal shaft *e*, on which the brake-wheel will fall to be mounted. Fig. 6. is an elevation of the masonry of the lock marked A A A A; letter C is the level of the upper, and B of the lower railway; *a a a a* are the wheels on which the pitch-chains revolve, *b* is their axis, *c* the spur-wheel, *d* the pinion mounted upon the horizontal shaft *e*, both marked in dotted lines, *f f f* are the waggons supposed to be ascending or descending within the range of the lock, *h h h h* the pitch-chains, *i i i i i* are the studs upon the chains by which the waggons are suspended; the lower pair are seen entering the loops of the lower waggon *f*. Fig. 7. is a longitudinal section of the masonry of the lock, A A A A' show the walls, B B the lower railway, with its end B' turned up, as a stop for the waggons at the proper position for hooking and suspending them upon the chains. C C' show the level of the upper railway, *a a* mark one of the pitch-chain-wheels. The spur-wheel, pinion, and lying shaft not appearing in this figure, *f f f* are the ascending or descending waggons, as in Fig. 6. *g* is a waggon on the upper railway, and *k* another upon the lower railway. *h h h h h h* are the pitch-chains, the dotted part below being the track of the chains under ground. *l l* show the rollers for guiding them. *i i i i i* are the loops in the waggons, into which the studs enter for suspending them to the chains. In practice, guide-boxes for the chains are placed immediately below the level of the upper and lower railways, and upon each alternate link of the chain, a kind of bow of iron is formed, which passes through the guide-box, and keeps the chain in its proper position for hooking the studs into the loops of the waggons.

Authors who may be consulted:—Edgeworth on *Railroads*; Wilkes on *Railways*; *Report relative to various Lines of Railway, and Memorial relative to Opening the Great Valleys of Strathmore and Strathearn, by means of a Railway or Canal*, by Robert Stevenson, Civil Engineer, printed at Edinburgh, 1821; *Observations on a General Railway*, published in London, 1821; *Description of a Railway upon a New Principle*, by H. H. Palmer, Civil Engineer, London, 1823; *Transactions of the Highland Society*, vol. vi. Edinburgh, 1824.

RAIN. See Meteorology, Vol. XIV. page 164—169; and Physical Geography, Vol. XVI. page 512—517. See also Meteorites, Vol. XIV. for an account of showers of organised matter.

RAIN-BOW. See Optics, Vol. XV. p. 616.

RAIN-GAGE. See Meteorology, Vol. XIV. page 152.

RAJEMAHAL, the name of an ancient city of Bengal, which has recently fallen into decay. It stands on the west bank of the Ganges, at the foot of a range of hills. The modern part of the town consists of a single street, with houses of stone about two stories high. The ruins of a palace still attract attention. The view of Rajemahal, with the mountains at the back of the town, is much admired. The chief occupation of the people is supplying the neighbourhood with flags and millstones. This city has been ruined by an inundation of the Ganges, by a conflagration, and by the removal of the seat of government to Dacca. E. long. 87° 43', N. lat. 25° 2'.

RALEIGH, Sir Walter, a distinguished author and adventurer, was the fourth son of Walter Raleigh, Esq. of Fardel, in the parish of Cornwood in Devonshire, was born in 1552 at Hayes, in the parish of Budley, a farm which formed part of his father's property. By his mother's side he was nearly connected with those celebrated knights, Sir John, Sir Humphrey, and Sir Adrian Gilbert.

After receiving the common school education of that period, he was sent to Oriel College, Oxford, where he was noticed for his proficiency in his studies; but he remained here only a short time, and was hurried into a less peaceful career by his passion for military adventure.

At the early age of seventeen, he went as one of the hundred volunteers under Henry Champernon, whom Queen Elizabeth sent with other English troops to France, to assist the queen of Navarre in defending the protestants who were then severely oppressed. In this service he studied the art of war for five or six years, but it does not appear how he escaped the dreadful massacre of St. Bartholomew, which extended through several of the provinces of France. In the year 1575 he returned to England, and took up his residence in the Middle Temple, from which we find a commendatory poem dated, which is prefixed to a work of George Gascoigne's, in 1576. In 1577, he embarked for the Netherlands, along with the troops which the queen sent to the assistance of the Dutch against Spain, and in this adventure he occupied himself in acquiring much useful knowledge, independently of military experience; and when he returned to his own country, he was regarded as one of the best bred and most accomplished gentlemen in England.

Sir Humphrey Gilbert, the half-brother of Raleigh, obtained a patent to plant, colonise, and explore some parts of North America. In this adventure, Gilbert was aided by several of his friends, and Raleigh entered into the scheme with a zeal corresponding to his love of enterprise and wealth. This expedition turned out a very unfortunate one to its projectors. The ships met with a Spanish fleet, and after a smart engagement, they returned without success in the spring of 1579, Raleigh having obtained no other advantage but a knowledge of naval service, which contributed so much to his future aggrandisement.

Pope Gregory VIII. having in conjunction with the King of Spain, projected a total subjugation of England, had sent troops, money, and military stores to Ireland, to aid the Desmonds in the Munster rebellion. Raleigh offered his services to the queen on this occasion, and obtaining a captain's commission under Lord Grey of Wilton, then deputy of Ireland, he embarked for that kingdom, and by his services in Munster under the Earl of Ormond, he contributed to quell this ill-devised commotion. His skill and personal courage raised him to the situation of Governor of Cork, and, as a reward for his services, he obtained from the crown the grant of a considerable estate in Ireland. A misunderstanding, however, having taken place with Lord Grey, his farther promotion in Ireland was stopped; and he returned to England, where he was introduced to Queen Elizabeth, and speedily insinuated himself into the royal favour. His handsome personal appearance, his elegant address, and that air of gallantry which Elizabeth so much admired, contributed no doubt to fix upon him the queen's particular attention. An accident, however, of a more trivial nature, is said to have had its full share in securing him the royal favour. When Raleigh was one day in attendance upon her majesty, in her morning walk, they arrived at a part of the road which was wet and covered with mud. The party had scarcely recognised that the path was but little fitted for royal footsteps, when Raleigh took off his rich embroidered mantle and spread it on the ground. Her majesty, pleased and surprised with this unpremeditated piece of gallantry, stepped gently upon the cloak, and is said to have jocularly remarked, that this sacrifice of a cloak might obtain for him many a good suit.

Raleigh was next employed by the queen as attendant on the French ambassador Simier, on his return home; and he was one of the party who accompanied the Duke of Anjou from England to Antwerp, where he became acquainted with the Prince of Orange, and brought over letters from him to her majesty, on his return to England in 1582.

The favour which Raleigh now enjoyed was not confined to the vicinity of the court. Even the statesmen of different parties showed him the highest respect, and strove who should extend to him the most active patronage. His half brother, Sir Humphrey Gilbert, had planned a second expedition to Newfoundland, for which Raleigh built a new vessel called the Bark Raleigh, and completely furnished it for the voyage. Fortunately, however, he did not accompany it in person, for a contagious distemper broke out among the ship's crew, and forced the vessel to return to Plymouth in less than a week.

This disappointment, which would have paralysed the energies of ordinary temperaments, seems only to have roused the ardour of Raleigh for farther adventures.

In 1584 he submitted to the queen and council a scheme for exploring North America, and making settlements in those parts of it which had not been subjugated by any foreign power. This scheme was too plausibly stated, and the interest of its author too powerful to meet with any opposition. An extensive patent was immediately granted to him for executing the plan; and, with the assistance of his friends, he fitted out two vessels entirely at his own cost, which were put under the command of Captains Amadas and Barlow, and which sailed from Plymouth in 1584. Upon reaching the American coast, they took possession of an island near the mouth of Albemarle river, in North Carolina, and the ships returned in autumn with various commodities, which brought such a high price, that the company of Raleigh's friends who had assisted him, fitted out a fleet of seven vessels, the command of which was intrusted to Sir Richard Greenville, a relation of Raleigh's. In the course of this voyage they took possession of a fine country called Windungocoa, to which Elizabeth herself gave the name of *Virginia*. Sir Richard left a colony of 107 persons at Roonah, under the government of Mr. Lane; but misfortunes of various kinds befel the colony, and, after expending large sums of money in fruitless attempts to repair them, he assigned over his patent to a company, reserving to himself only a portion of the gold and silver harvest which it was expected they would reap. It was from this colony that Raleigh first imported tobacco into England, and introduced the culture of the potato into his estates in Ireland.

It was about this period that he was elected knight of the shire for the county of Devon; and soon after this, her majesty conferred upon him the honour of knighthood.

In another expedition which he fitted out for Virginia in 1585, his ships took a prize worth L.50,000; and he was also concerned in Captain Davis's expedition for the discovery of a north-west passage, from which circumstance a promontory in Davis's Straits was called Mount Raleigh.

With the view of indemnifying her favourite for his outlays in these public-spirited enterprises, the queen gave him several profitable grants. Among these were the power of licensing retailers of wine throughout the kingdom, and a seigniory of 12,000 acres of forfeited lands in the county of Cork in Ireland, which he planted at his own expence, and sold many years afterwards to Richard Boyle, the first Earl of Cork. In 1586 he was appointed seneschal of the dutchies of Cornwall and Exeter, and warden of the Stannaries; and such a hold did he seem to have taken of the queen's regard, that the Earl of Leicester himself, the queen's favourite minister, took the alarm, and brought forward the Earl of Essex as his rival.

In the year 1587, Sir Walter sent another colony of 150 men to Virginia, under the charge of Mr. John White as governor, with twelve assistants. About this time Raleigh was captain of the queen's guard, and lieutenant-general of Cornwall, in which last capacity he was of great use in training the county militia. In consequence of his political sagacity, as well as his military experience, he was a member of the council of war appointed by the government for devising the best means of resisting the threatened dangers of that period; and when the Spanish armada showed itself in the Channel, he was one of the enterprising volunteers who joined the English fleet with ships of their own, and shared in the glory of defeating the enemy. Raleigh was now made gentleman of the queen's privy chamber, and the profits of his other situations were greatly increased.

In 1589 Raleigh was one of those who accompanied the exiled king of Portugal in his attempt to recover his throne. Upon his return from this expedition, he went to visit his estates in Ireland, where he either formed or renewed his acquaintance with Spenser the poet, who has celebrated him under the appellation of the shepherd of the ocean, and who acknowledges the obligation which he owed to Raleigh, of having first introduced him to the queen. Spenser also prefixed to his Fairy Queen an introductory letter to Raleigh, in which he explains the plan and object of that poem.

Eager for new enterprises, our military knight conceived the design of attacking Panama, and intercepting the Spanish Plate fleet. No fewer than thirteen ships were fitted out by himself and his friends for that purpose, and these were joined by two men of war, all of which were put under the management of Raleigh. He was, however, recalled by the queen, when he had scarcely set sail; but before he returned he proceeded to Cape Finisterre, and divided his fleet into two squadrons with cruising orders. A rich carrack which fell in the way of one of these squadrons, was the only prize of the expedition. In the year 1594 he obtained from the queen a grant of the manor of Sherborne, in the county of Dorset, upon which he erected a magnificent house; but the tide of fortune, which had thus lifted him to the highest summit of its wave, was now beginning to subside gently beneath him. An infamous person of the name of Parsons, a Jesuit, wrote a libel, in which he charged Raleigh with atheism. This imputation, groundless as it was, is still said to have created some disagreeable feelings towards him on the part of the queen; but these feelings were increased to a still greater degree by an intrigue with one of her maids of honour, the daughter of Sir Nicholas Throgmorton. The court of the queen was scandalised by this indecent amour; but her favourite made all the reparation which he could, by marrying the lady, with whom he lived in great conjugal felicity. The queen, however, testified the weight of her displeasure, by committing him to the Tower for some months, and subsequently banished him from her presence.

In the solitude of his confinement, the imagination of Raleigh seems to have been fascinated by the marvellous tales which had been circulated respecting the riches of Guiana, and he projected an expedition for exploring that country. Guided by some private information which he had obtained from an old navigator whom he had dispatched on purpose, he embarked in July 1595, with a squadron of ships, and made for the island of Trinidad. After taking possession of the town of St. Joseph, he sailed up the great river Oroonoko; but the impediments to its navigation which he experienced, and the intolerable heat of the climate compelled him to return, after taking possession of the country in the queen's name. Raleigh appears to have been annoyed with the unsuccessful issue of this expedition; and it is not easy to reconcile with his character as an honest man, the account of the country which he published on his return, under the title of, "Discovery of the large, rich, and beautiful Empire of Guiana." Hume stigmatises this production as "full of the grossest and most palpable lies that were ever attempted to be imposed on the credulity of mankind."

The queen had so far forgotten her displeasure against Raleigh, as to give him a naval command as admiral, in the successful expedition against Cadiz in 1596, which was sent out under Lord Howard of Effingham and the Earl of Essex. In 1597 he held the post of rear-admiral in the expedition commanded by Essex, and sent to the Azores for the purpose of intercepting the Spanish West India fleet. Having arrived with his squadron at Fayal before Lord Essex, and waited for a considerable time, he deemed it prudent to make an attack on the place, which, fortunately for himself, turned out successful. This event gave deep offence to the Earl of Essex. He considered Raleigh as having intentionally defrauded him of the glory of the action; and he would not have scrupled to cashier him, had not Lord Howard exerted himself in bringing about an apparent reconciliation. On the return of the expedition, Lord Essex publicly found fault with the conduct of his officers; but the queen, after deliberately considering the whole transaction, seems to have considered the conduct of Sir Walter and the other officers as justified by the circumstances of the transaction.

Sir Walter now devoted himself, with his usual ardour, to the affairs of parliament, and we find him taking a leading part in all jousts and tournaments. In the year 1600 he went out as joint ambassador to Flanders along with Lord Cobham, and on his return he was appointed governor of Jersey. In 1601 he attended the queen in a progress through part of the kingdom, and he was soon after appointed to receive and confer with the Duke of Biron, on his arrival as ambassador from France.

When his rival, the Earl of Essex, had been condemned to death for high treason, Raleigh is said to have indecently urged his execution on the minister Cecil; and, what is still more unworthy of his name, he is reported to have been an eye-witness of the execution. The death of Queen Elizabeth in the beginning of 1603, which was probably accelerated by the fate of her favourite Essex, gave a blow to the fortunes of Raleigh from which he never recovered.

When James VI. ascended the throne, he brought with him many feelings which were not favourable to the interests of Sir Walter. James had naturally a prepossession against him as the enemy of Essex; and this was much increased when he found that he was one of a party that had conceived the design of forcing the king to limit the number of Scotsmen whom he was to bring along with him. Although Raleigh made no slight struggle to displace Sir Robert Cecil from the king's confidence, yet his efforts were in vain, and he was scarcely received with ordinary civility. Accustomed to the sunshine of royal favour, and to the respect and admiration of all ranks, the chivalrous spirit of Raleigh could but ill brook this haughty and unmerited treatment. At first, indeed, he seems to have sunk under the royal frown; but, by a revulsion not unnatural in his circumstances, a sentiment of revenge speedily displaced that of despondency, and the influence of his name and his talents was thrown into the scale of disaffection. The enemies of James, who had conspired to place Lady Arabella Stuart on the throne, appear to have availed themselves of Raleigh's excited feelings, and to have induced him to participate in this ill-contrived and absurd treason. Raleigh was immediately apprehended and charged with the highest of political crimes. His accuser was Lord Cobham, an unprincipled nobleman, who was himself concerned in the plot, and to whose own proposals Raleigh seems only to have listened. Sir Walter was indicted for conspiring to deprive the king of his throne, to raise up sedition within the realm, to alter the religion, to bring in the Roman superstition, and to procure foreign enemies to invade the kingdom. The principal overt act laid in the indictment was, that he had a conference with Lord Cobham on the best means of advancing Lady Arabella Stuart to the crown, and of applying to the king of Spain to procure his assistance. In his defence Sir Walter displayed the greatest eloquence as well as temper and force of argument, and he made an able stand against the legality of conviction upon the evidence of a single witness. These objections, however, were overruled, and the judge degraded his office by passing sentence on Raleigh. Even Coke, the attorney general, who used the vile privileges of a lawyer in abusing Raleigh, could not avoid expressing surprise at the sentence, and declared that he had charged him only with misprision of treason. Three of the conspirators in this plot were executed, two were pardoned, and Raleigh, who had only obtained a reprieve, was committed to the Tower.

In this condition of hopeless confinement, his wife was, at her own earnest desire, allowed to live with him, and their youngest son was born in the Tower. To beguile the tedium of confinement, Sir Walter devoted his mind to study, and composed the greater number of his works, especially his *History of the World*, a production remarkable for the purity and vigour of its style. The situation of our author seems to have excited much commiseration and sympathy. Even Prince Henry, a youth of warm affection and great promise, not only cherished the highest admiration for the talents of Raleigh, but ventured to correspond with him, and to relieve the solitude of his confinement by his sympathy and friendship. "No king," the prince is reported to have said, "but my father, would keep such a bird in a cage." The death of this generous prince, however, extinguished in the mind of Raleigh all hope of deliverance.

In March 1616, after an imprisonment of twelve years, he at last obtained his freedom, but not, as has been supposed, without heavy bribes paid to the Duke of Buckingham. Notwithstanding the failure of Raleigh's last adventure to Guiana, he planned a new expedition to that land of gold, and by circulating the report that a rich gold mine existed in it, he engaged a number of speculators to embark their capital; and in August 1616, he obtained from the king, and under the great seal of England, a patent for making a settlement in Guiana.

In order to retain a hold upon Raleigh, James had never yet granted him a pardon; and as this could easily have been purchased, Sir Walter consulted Sir Francis Bacon respecting the propriety of his paying a sum of money for the royal mercy. This great lawyer is said to have replied, "The knee timbers of your voyage is money; spare your purse in this particular, for upon my life you have sufficient pardon for all that has past; the king having under his broad seal made you admiral of your fleet, and given you power of martial law over your officers and soldiers."

In July 1617, Raleigh sailed for Guiana with his armament of twelve vessels, upon which he had lavished all his resources. He was compelled, however, by stress of weather to put into Cork harbour, where he continued till the 19th of August. He reached Guiana in November; and the Indians, who received him with open arms, offered him the sovereignty of the country, which he of course refused. A severe and lengthened illness, however, prevented him from exploring the mine of gold; but Kemys, one of his captains, made the necessary search, and found to his great mortification, that the Spaniards had anticipated him in the search for this precious metal. The eldest son of our author lost his life in this expedition; and Captain Kemys, in consequence of having been severely reproved for the failure of his search, put an end to his own life.

Thwarted in this favourite object of his ambition, in the success of which his judgment and character were in no small degree compromised; and wounded in his tenderest feelings by the loss of his son and of his captain, he steered homewards with a heavy sail, and arrived at Portsmouth in July 1618.

It has been said, but we presume not upon good authority, that the whole of Raleigh's scheme had been revealed to the Spaniards by King James himself, for the express purpose of getting rid of him. This opinion, indeed, receives some confirmation from the subsequent conduct of James. No sooner had Raleigh set off for London from Plymouth, than he was arrested and imprisoned. The two attempts which he made to escape, indicate the light in which he viewed the royal temper; but in both of them he was baffled, and he was secured and committed a prisoner to the Tower.

The Spaniards, indeed, had entered a strong remonstrance against Raleigh's invasion of their territory; and as they were then at peace with England, James affected to be highly exasperated at the injury which they had received. His future views, too, with regard to Spain, strengthened this feeling, and he seems to have resolved to sacrifice Raleigh to the resentment of that nation.

In a country such as England then was, and in an age when a sense of strict justice, and the nature of judicial evidence were less attended to than they were understood;—it was difficult even then to contrive a decent pretence for taking away the life of Raleigh. Commissioners were appointed to inquire into his conduct in Guiana; but no act during that expedition could be fixed upon as a ground for putting him on his trial. It was therefore resolved to revive his former sentence, and on this ground he was brought before the king's bench. It was in vain that he urged his plea of an implied pardon; it was in vain that he produced the king's commission under which he had acted as a subject alive in the eye of the law. Justice was now really and no longer metaphorically blind. The equilibrium of her scales was overset by the whole weight of the royal resentment; and with one hand clenched in rage, she pronounced a sentence of condemnation, the basest and the most flagrant that ever disgraced the darkest era of barbarism, or the most flagitious convulsion of civilized society. We forget the name of the judge who lent his conscience to that nefarious decision —and may it for ever be forgotten; lest some honest man who may not have courage to renounce it, may partake in the infamy with which it must ever be associated.

The sentence of death was pronounced on Raleigh on the 28th of October 1618, and on the 29th he was executed in Old Palace-Yard, and his remains interred in St. Margaret's Church, in the vicinity. His behaviour on the scaffold was such as might have been expected from a man who had so often braved death for his own purposes. He made a speech to the mob. He declared that he had no fear of death, and that he would rather die on the scaffold than in a burning fever. He requested a sight of the axe, and feeling its edge, he said to the sheriff, "This is a sharp medicine, but a sure remedy for all evils." Being asked by the executioner how he would wish to place himself on the block? he replied, "So the heart be right, it is no matter which way the head lies." He then gave the signal, and was thus murdered in the sixty-sixth year of his age.

The different compositions of Raleigh's which were poetical, geographical, political, philosophical, and historical, were published in 2 vols. 8vo. in 1748. His *History of the World* has been several times reprinted. He brought it down no farther than the overthrow of the Macedonian empire. See the *Biographia Britannica;* Campbell's *Lives of the Admirals;* and Cayley's *Life of Sir Walter Raleigh.* Lond. 1806.

RAM, Hydraulic *Montgolfier's.* See Hydrodynamics, Vol. XI. p. 566.

RAMEAU, John Philip, a celebrated musical composer and writer on music, was born at Dijon in 1683. At an early period of his life he went into Italy, and on his return he was appointed organist of Clermont in Auvergne. In this situation he composed his *Traité de la Musique*, which appeared in 1722, and which gained him great reputation. The principles which he laid down were made the foundation of D'Alembert's work on Music, which was entitled, *Elémens de Musique Théorique et Pratique Suivant les Principes de M. Rameau.* From Clermont he went as organist to St. Croix de la Bretonniere at Paris; and he now employed himself chiefly in teaching music, and in drawing up some theoretical works. At the age of fifty, however, he began in 1733 to publish his musical compositions, the first of which was the Opera of *Hippolyte et Aricie*, which excited general notice. Between 1733 and 1760, he composed twenty-one operas of various degrees of merit. His Castor and Pollux supported an hundred representations, and is said to have been particulary admired. Rameau died in the year 1767 at the age of eighty-four.

RAMILLIES, Battle of. See the article Britain, Vol. IV. p. 618.

RAMISERAM Isle, is the name of an island sacred among the Hindoos, and situated between Ceylon and the continent. It is about eleven miles long and six broad, and contains a large town called Pauban. It is principally celebrated, however, for its temple, dedicated to the demi-god Ram. This temple is built in a style of massiveness resembling those in Egypt. The entrance is through a lofty gateway 100 feet high, constructed of large stones, many of which contain figures of the Hindoo gods in relievo. The image of Ram is daily bathed in water, brought from the Ganges, a distance of 1000 miles. It is a place of great resort for pilgrims, and the rajahs of Travancore are said to have spent £25,000 in their visits to it. The strait which separates the island from the coast of Coromandel is about a mile wide. East Long. 79° 21′. and North Lat. 9° 17′.

RAMSAY, Allan, a Scotish poet of considerable celebrity, was born at Leadhills in Lanarkshire in October 1686. His father was occupied in the management of Lord Hopetoun's mines; but having died early, and his widow having married again, their son Allan seems to have been employed till his fifteenth year, in the ordinary operations of working and preparing the lead ore for smelting.

In 1701, he was bound apprentice to a wigmaker in Edinburgh; and he seems to have exercised this profession till the year 1716. One of the earliest of his productions now known, was an Address to the Most Happy Members of the Easy Club, which appeared in 1712, when he was only 26 years old. The reputation among his acquaintances, which this and other pieces obtained for him, induced him to exchange the occupation of a wigmaker, for the more literary one of a bookseller. In 1721, he published by subscription his detached poems in 1 vol. 4to. In 1724, he published the first volume of his well-known collection, called, The Tea Table Miscellany; the second appeared soon after; the third in 1727; and the fourth, after another similar interval. He next published what he called the Evergreen, a collection of Scotish poems, written prior to 1600.

In the year 1725, Ramsay brought out his Gentle Shepherd, a work which will continue to be read as long as the Scotish language shall be understood. The first part of the drama called Patie and Roger, appeared in 1721, and the second, entitled Jenny and Meggy, in 1723; but under its new title, it was formed into a regular dramatic composition.

A second volume of his poems appeared in 1728; and so widely had these writings extended his fame, that a new edition of his poetical works was published by the London booksellers; and two years afterwards, they were re-printed at Dublin. Allan Ramsay is said to have been the first person who established a circulating library in Edinburgh. He published a collection of fables in 1730, which terminated his labours as an author.

But though he now laid aside his pen, yet his active mind would not suffer him to be idle. He built, at his own expence, the first theatre for dramatic performances in Edinburgh, which was opened in Carruber's Close, in the year 1736. He was obliged, however, by the Magistrates to shut it up, as he required his Majesty's letters patent for such an establishment. In the year 1755, in the 69th year of his age, our author quitted the profession of a bookseller, and retired to a small house, which he had built on the north side of the Castle Hill. He was now attacked with a severe scorbutic complaint, by which he lost all his teeth, and which put an end to his life, on the 7th of June 1758, in the 71st year of his age.

His son, Allan Ramsay, who was born in 1709, attained to considerable eminence as a painter of portraits, his skill in which he had improved considerably by four visits to Italy. He was the author also of some literary productions, which never excited much notice. He was a man of good character, was painter in ordinary to the King for England, and lived to the advanced age of 75.

RAMSDEN Jesse, a celebrated English mathematical and astronomical instrument maker. He was born in 1735, and was the son of an innkeeper at Salterhebble, near Halifax in Yorkshire. From the free school of Halifax, where he acquired, between the age of 9 and 12, the elements of a classical education, he went to his uncle at Craven, who sent him to the school of the Rev. Mr. Hall, who had gained some credit in teaching the mathematics. Here Ramsden studied geometry and algebra; but his course was very short, as his father soon afterwards apprenticed him to a clothier of Halifax as a hot-presser. In 1755, he became a clerk in a wholesale cloth warehouse in London, a situation in which he continued for two years and a half; but his passion for the sciences could no longer be controlled, and he bound himself for four years to Mr. Barton in the Strand, who was skilful in the division of mathematical instruments, as well as in the other branches of his trade. When his period of servitude had expired, he wrought as a journeyman with Mr. Cole, with whom he afterwards connected himself as partner. He very soon, however, opened a shop fon himself, and acquired the good opinion of the principal philosophical instrument makers in London. His marriage with Miss Dollond, brought him into still greater notice, and with her he obtained a part of Dollond's patent right for achromatic telescopes. In the year 1766, Ramsden had opened a shop in the Haymarket; but he had before this invented his celebrated dividing engine, of which we have given an account in our article Graduation, Vol. X. p. 352. His engine had many imperfections; but the ingenuity of its author produced a more perfect one, an account of which was published by the board of Longitude in 1775, who rewarded him with the sum of L.615.

In the year 1779, Mr. Ramsden, under the patronage of the board of Longitude, published an account of his engine for dividing straight lines, of which we have given drawings and a full description, in the article Graduation already quoted.

While Mr. Ramsden thus improved the art of graduation by these valuable engines, he made himself universally known by the splendid astronomical instruments which he constructed, and by the great accuracy with which his circles and nautical instruments were divided. His nautical instruments, such as sextants and small circles, were all divided by the engine; a method which he introduced, and which will never be superseded in the graduation of instruments of moderate size. Unfortunately our author has not published any account of the method by which he divided his great circles, so that we are left to form those conjectural opinions about it which have been stated in the article Graduation, Vol. X. p. 370.

In the manufacture of philosophical instruments, which Mr. Ramsden carried on to a great extent, he collected in his workshops men of every branch of trade necessary for their construction. The same workmen were always confined to the same kind of work; so that they were enabled to execute it with wonderful perfection. In consequence of their cheapness, as well as their accuracy, the demand for his instruments was so great, that though he constantly employed sixty men, yet he was unable to execute the numerous orders which he received. Mr. Ramsden was elected a Fellow of the Royal Society of London in 1786, an honour which is always limited to two or three of the first rate artists in the metropolis. He was elected a Fellow of the Imperial Academy of St. Petersburg in 1794; and in 1795, the Royal Society adjudged to him the Copley medal for his various inventions. His health was greatly impaired by his devotion to his profession, and he died at Brighton, which had been recommended to him for the sea air, on the 5th November, 1800.

Mr. Ramsden was a man of acute judgment and fine taste, in all matters connected with his profession. As a relaxation from its severities, he perused the best authors both in prose and verse, and he was particularly fond of Boileau and Moliere.

The following is a list of several of Mr. Ramsden's inventions and instruments, with references to the parts of this and other works where a description of them will be found.

Ramsden's Circular Dividing Engine. See the article Graduation, Vol. X. p. 352.

His Straight Line Dividing Engine. See Graduation, Vol. X. p. 357—361.

N. B. Both these engines are described in separate works published by the Board of Longitude.

Ramsden's Catoptrical Micrometer. See Micrometer, Vol. XIV. p. 207.

His Dioptrical Micrometer. Ditto, p. 208.

His Circles for the Observatories of Dublin and Palermo, and his Great Equatorial, are described in our article Circle, Vol. VI. p. 484, 485.

Ramsden's Optigraph. See Optics, Vol. XV. p. 665.

Ramsden's Dynameter. See Optics, Vol. XV. p. 649.

Ramsden's Eyepiece. See Achromatic Telescopes, Vol. I. p. 109; and Microscope, Vol. XIV. p. 229.

For a full account of Ramsden's life, see the *General Biography*, vol. viii.

RAMSEY. See Man, *Isle of*, Vol. XIII. p. 301, col. 2.

RAMSEY. See Pembrokeshire, Vol. XVI. p. 352, col. 2.

RAMSGATE, a sea port town of England, in the county of Kent, is situated on the shore of the German Ocean, and on the east coast of the Isle of Thanet. The streets of the town, which are numerous, are well paved and lighted, and the houses are in general well built and handsome. Among the new streets which have been added to this town, are Chapel, Albion, and Prospect Places, Sion and Prospect Hills, Nelson's Crescent, St. George's and Sion Row, Rose Hill and Bellevue Places. The parish church is at St. Lawrence, a large village situated on the brow of the hill which overlooks Ramsgate, and forming a long winding street on the high road to London. The church is a spacious edifice, consisting of a nave, aisles, and three chancels, with a square tower of Norman architecture. There is also a chapel of ease, built in 1785, which is a neat building; and chapels for Methodists, Baptists, and Independents. The assembly room and tavern is a spacious building near the harbour, and is elegantly fitted up with convenient tea and card rooms, a coffee-room and a billiard room. There are two extensive libraries here, one in the High Street and the other in Cliff Street, Sion Hill. A spacious and convenient poor-house has also been recently erected. There is here a charity school for boys and girls, and several good day schools, and excellent boarding schools.

The most interesting object at Ramsgate is its harbour, which was completed in 1791, at an expence of L.600,000. It is nearly of a circular form, and has an area of about 46 acres. The piers consist principally of Portland and Purbeck stone, and the general breadth is about twenty-six feet, including the strong parapet which defends the outer sides next the sea. The total length of the east pier, including its flexures, is nearly 2000 feet, and that of the west pier about 1500 feet. These two piers extend about 800 feet into the sea, bending towards each other like two arms, and leaving an entrance of 240 feet. A basin was afterwards erected within the harbour to retain the tide water, and let it off again at every ebb, for the purpose of forming an artificial current, to carry off the sand deposited in the harbour. This contrivance, recommended by Mr. Smeaton, answered its object completely. An advanced pier was begun in 1787, to facilitate the entrance of vessels in stormy weather. A military road, connecting the centre and outward piers, has been made under the cliff, for the embarkation of troops. A dry dock and various storehouses have also been built. Between 1791 and 1802 a new star light-house has been erected on the head of the west pier, a house for the trustees, a house for the harbour master, and a watch-house. A large dock-house has also been built, and very recently a wet dock has been erected near the basin. A battery near Albion Place, and another on the opposite cliff, defend the entrance of the harbour. The east channel is formed by the passage between the east pier and a large sand bank, which nearly crosses the harbour as far as the basin. In heavy gales ships bring up upon it when driven into the harbour without anchors or cables. Near the north end of the west pier is a massive frame-work of timber, and a staircase called Jacob's ladder, which forms a communication between the top and bottom of the cliff.

In the year 1780 only twenty-nine vessels entered this port; but the number has since varied between 500 and 800 annually, and ships of 500 tons can easily enter it.

Ramsgate is now much frequented by invalids for sea bathing. The bathing place is a fine shore of soft and reddish sand, beneath the cliffs to the south of the pier. The machines, like those of Margate, consist of a short caravan, with a door and small flight of steps behind, by which the bathers descend into the sea, and are concealed from view by a pendent covering of canvass. Four hot baths of salt water have been erected, and likewise a plunge and shower bath, with convenient waiting and dressing rooms. The east pier is a favourite promenade in summer, and commands many fine sea views.

Ramsgate carries on a considerable trade with the ports of the Baltic. Boat-building and the repairing of ships occupy some attention.

Ramsgate is a member of the Cinque Ports of Sandwich, and is in subjection to the justices of that place. The mayor of Sandwich appoints a deputy or constable. Population 1811, 4221, and in 1821, 6031.

An account of the apparatus of a diving bell used at Ramsgate, by Mr. Smeaton and Mr. Rennie, is given in our article Diving Bell, Vol. VIII. p. 19—21. East long. 1° 25′. North lat. 51° 20′. See the *Beauties of England and Wales*, vol. viii. Hasted's *History of Kent*, and Lewis's *History of the Isle of Thanet.*

RANA. See Herpetology, Vol. IX. p. 36.

RANGOON, formerly Dagoon, a seaport town of the Birman empire, and province of Pegu, is situated in a healthy and fertile country, on the north bank of the east branch of the Erawadi or Rangoon river. Rangoon extends about a mile along the banks of the river, and is between one-third and one-half a mile in breadth. The city is a square, surrounded by a stockade fourteen feet high. On the north side it has an indifferent fosse crossed by a wooden bridge. On this side there are two gates, but on all the other sides only one. In several places there are wooden stages within the stockade, to hold musqueteers in case of an attack. The river is about twenty or thirty yards from the pallisade, and between it and the south side there are several ports, and three wharfs with cranes for landing goods. The river is commanded by a battery of twelve ill-mounted six and nine pounders. A sort of exchange where the merchants assemble, consisting of two wooden houses, stands close to the wharf.

The streets are narrow though straight. They are clean and well paved with brick, with numerous channels to carry off the rain, and crossed with strong wooden planks for bridges. The houses, which are generally of timber, are raised several feet from the ground on posts, the smaller ones being supported by bamboos, and the larger ones by strong timbers. The principal inhabitants reside within the fort, the shipwrights and inferior population inhabit the suburbs; and there is an entire street called Tackally, assigned to common prostitutes. Swine, which are public property, are permitted to roam at large about the town, for the purpose of destroying the filth below the houses.

The customhouse, which is a spacious building, is composed of brick and mortar, and roofed in with tiles. There are a number of wooden stages within it, for the reception of bales of goods.

At the former town of Tagoun, (the Dogon or Dagou of the universal history,) situated on an eminence about two miles from Rangoon, stands the celebrated temple of Gautama, sometimes called the temple of Shoe Dagoon. It stands on a hill which is of a conical form, having steps all round it, on which are set numerous images of Guatama. The road which leads from the city to the temple is formed with care, the rain being thrown to the sides by a wide causeway in the centre. In the vicinity of the town there are several kioums or monasteries, which are generally placed under the shade of pipal or tamarind trees, at a short distance from the public road.

According to Major Symes, the river of Rangoon is very convenient for the construction of ships. The spring tides rise twenty feet perpendicular, and as the banks are flat and soft, very little labour is necessary for the formation of docks. Nature, observes Major Symes, has done her part to render Rangoon the most flourishing seaport of the eastern world. The entrance of the river about twelve miles below Rangoon, and the banks on each side, bear a near resemblance to those of the Ganges, but the navigation is much more commodious. The channel is bold and deep, from six and a half to eight fathoms, uninterrupted by shoals or inequalities of soundings. At this place the breadth of the river is estimated to be from three-fourths to one mile.

The teak wood, the most durable that is known, from its containing great quantities of crystallized silex, is produced in inexhaustible abundance in the Birman empire. It grows some hundred miles up the country, and after being split into thick planks by wedges in the dry season, it is floated down the rivers in the rainy season. As ships can be built cheaper at Rangoon than at Calcutta or Bombay, European speculators resort to this place to have their ships built; but they procure their iron, masts, and capstans from other quarters. The Arabs, however, have had vessels of 600 tons burden entirely built at Rangoon.

In 1800, when the coppering and equipment was in the European style, ship-building was executed for £13 per ton.

The imports into this country are chiefly European goods, such as coarse piece goods, glass, hardware, and broadcloth, various cloths from India, tea and porcelain from China. The imports from the British settlements in 1794 and 1795 amounted to about £135,000 sterling. The principal exports are wax, ivory and timber.

There are fitted out annually at Rangoon ten or twelve boats, with about thirty more from different towns on the Erawadi, which proceed by way of the Bassien river, along the coast of Aracan to Lucknow, Calcutta, and even to Patna. They generally carry from 1000 to 1500 maunds, (80 lbs. each,) with from twenty to twenty-five men. The value of each boat is about 4000 rupees, chiefly in bullion; the rest of the cargo consisting of sheathing boards, sticks of copper from China, stick lac, cutch, ivory, and wax.

The population of Rangoon consists, beside the Birmans, of Malabars, Moguls, Persians, Parsees, Chinese, Armenians, Portuguese, French, and English; many of them insolvent debtors from the different settlements in India, who support themselves by carrying on a small trade. It contains 5000 registered taxable houses, which, reckoning six persons to a house, will give 30,000 inhabitants. The number of priests is estimated at 1500.

In January 1810, Rangoon was almost destroyed by fire. East long. 96° 9′, and North lat. 16° 47′.

See Syme's *Embassy to Ava;* and Cox's *Notes on the Birman Empire.*

RAPHAEL, Sanzio da Urbino, one of the most celebrated painters; was born at Urbino in Italy, on the 28th of March 1483. The talent for painting which he early exhibited was carefully cultivated by his father John Sanzio, who was himself a painter of moderate talents, and who received from his son, when at a very early age, much assistance in finishing several pictures which he was painting for his native city of Urbino. Raphael was placed under the tuition of Carnevale or Corradini, with whom he remained till he could be received under the care of Pietro Perugino, a celebrated artist of Perugia. The pupil acquired so speedily and perfectly the manner of his master, that connoisseurs could not distinguish between their works, so that he soon became the rival of Perugino.

Raphael appears to have left Perugino about the age of sixteen or seventeen, when he went to Citta di Castello, to paint a St. Nicholas crowned by the Virgin and St. Augustine, for the church of St. Augustine, and another of the crucifixion of our Saviour, for the church of St. Dominic. These works were regarded as equal to those of Perugino; but in a third picture of the marriage of the Virgin and St. Francisco, painted for the church of St. Francisco, in the same city, he was allowed to have far surpassed his master.

The celebrity which these pictures procured for Raphael induced his friend Pinturicchio, in the year 1503, to engage him to compose designs from the history of Pius II., for the Library of the cathedral at Sienna, which the Pope had employed him to adorn. Having begun to prepare the cartoons for this purpose, his progress was stopped in consequence of hearing of the great cartoons at Florence which Leonardo da Vinci and Michael Angelo had painted for the council hall of that city. He immediately went to Florence, along with some of his brother painters, in order to see these great productions of art. But grand as these objects were, Raphael found others equally attractive. He saw at Florence so many beauties, both of nature and art, that he determined to take up his residence in that city. His reputation, which had preceded him, introduced him to the best society, and his elegant person and agreeable manners gained him many friends among those who neither valued talents, nor were able to appreciate his. Among his friends he soon numbered the artists Ghirlandaio, St. Gallo, and Taddeo Taddi, the last of whom laid open the hospitalities of his house and table to our young artist. In return for this kindness, Raphael presented his friend with two pictures which he had painted at Florence; one of which, a Madonna and child, with St. John bringing a little bird to him, was sold to the Archduke Ferdinand at a great price.

The death of both his parents recalled our young artist to Urbino, where he was engaged by Guidobaldo de Montefeltro, and others, to paint subjects for the altars of their chapels, among which were the two little Georges now in the Louvre. Vasari mentions another of these, viz. Christ praying in the garden, painted with all the minuteness of a miniature for the Duke of Urbino. This, however, and others of the same class, are not to be found.

From Urbino Raphael went to Perugia, where he painted a picture of the Virgin with St. John the Baptist and St. Nicholas, for the church of the Fratri de Servi; a fresco picture of Christ in glory, with God encircled with angels and six saints for the church of St. Stephen. Raphael seems to have been so much pleased with this picture, that he inscribed his name upon it in large golden letters.

Raphael also executed at this time for the nuns of St. Antonio da Padua, a picture of our Lady, with the infant upon her lap clothed, and near her St. Peter, St. Paul, St. Cecilia, and St. Catherina. The two female heads have been particularly admired. In a semicircle at the top of the picture was represented the Almighty, and in three compartments at the foot of it were the agony in the garden, the carrying of the cross, and a dead Christ in the lap of the Virgin. It is at present unknown what has become of the centre picture, or of the semicircular one; but the lower ones formed a part of the Orleans collection.

Soon after he had finished these works at Perugia Raphael paid a second visit to Florence, with the view of still farther improving himself in his profession. Having carried with him a letter of introduction from the dutchess of Urbino to Pietro Soderini Gonfaloniere, he was soon admitted into the best circles; but his attention was almost entirely engrossed in studying the cartoons of Michael Angelo and Leonardo da Vinci, and the works of Masaccio, in the Brancacci and Corsini chapels in the church of the Carmelites. His acquaintance with Buccio della Porta, by others called Fra Bartolomeo, was of essential service to him. From him he learned the art of casting draperies, and the principles of colouring and chiaro oscuro, and to Bartolomeo he taught, in return, the art of perspective.

The pictures which he painted at this time were the portraits of Angelo Doni, and his wife Maddalena Strozzi, and a Madonna with the infant playing with St. John, brought by Elizabeth, who regards St. Joseph as he stands near, leaning both his hands upon a stick, and inclining towards her his head. This picture, which was painted for Dominico Cauregiani, seems to have been either retouched or completed in 1516, as Raphael's name with the date is written on the drapery of the Virgin in letters of gold.

During this residence at Florence, Raphael painted a cartoon for a picture bespoken by the Baglioni family at Perugia; but he now left Florence to paint it at the church of St. Francis in Perugia. This picture, which has been greatly admired for the beauty and expression of the figures, and the superiority of the draperies, was one of our Saviour borne to the sepulchre, accompanied by the Virgin, St. John, &c. Pope Paul V. removed it from Perugia, and substituted a copy by Caesare d'Arpino. It was afterwards found in the Borgherse Palace at Rome.

Upon his return from Perugia to Florence, he paint-on the Whigs and Tories, and his great work, the *Histoire d'Angleterre* appeared at the Hague in 9 vols. 8vo. in 1725, 1726, embracing the history of England from the earliest periods down to the Proclamation of William and Mary. While he was collecting the materials of that work, he made "An Abridgement of Rymer's Fœdera," which was published in Le Clerc's *Bibliothèque Choisie*.

Rapin died of a fever at Wesel, on the 16th of May, 1725, in the 64th year of his age.

RASTADT, a town of Germany, in the duchy of Baden, and chief place of the district of the Murg, is situated on the Murg not far from the Rhine. The town is new and regularly built, and the principal street is broad and handsome. It is surrounded by a mound of earth, and contains the fine mansion of the Princes of Baden. The principal manufactures are those of carriages, fire-arms, silver, and plaited goods, and mathematical and philosophical instruments. There is here an institution for the education of young ladies. The romantic valley of the Murg, which is considered as Switzerland in miniature, deserves to be visited by every traveller. Population about 4200. East long. 8° 15', and north lat. 48° 52'.

RAT. See MAZOLOGY, Vol. XIII, p. 438, 440.

RATAFIA, the name of a liquor made from the kernels of cherries, apricots, &c. In making the Ratafia of cherries, the cherries when bruised are put into a vessel in which brandy has been long kept, and then there is added the kernels of cherries, strawberries, sugar, cinnamon, white pepper, nutmegs, cloves, 10 quarts of brandy being added for 20 lbs. of cherries.

RATHLIN, the name of an island situated between the north coast of Ireland and Scotland. It is about six miles long, and two and three-fourths of a mile broad, having an indentation towards the middle, which forms a large bay called Church Bay, which, except in westerly winds, affords good anchorage and a safe harbour for shipping. The number of plantation acres is about 200, which produce good barley. Kelp, however, is the principal source of wealth in the island, about 100 tons being exported annually. Tumuli containing bones are found here, and also brazen swords and spear heads. Rathlin is celebrated as the place where Robert the Bruce fled from his enemies, and the remains of the fortress are still seen in which he is said to have defended himself. Population about 1100. West Long. 6° 6'. North Lat. 55° 20'.

RATIO.*

UNDER this article the attainment of three important objects in science has been attempted. The first aimed at, was all the perspicuity of treating proportionality, or comparison of ratios, of which it is susceptible: †. the second was a satisfactory demonstration of the fifth definition of the fifth book of Euclid; ‡ and the third, an easy way of extending the subject by means of numbers, expressing the relative values of the magnitudes under consideration. The consequences of these endeavours are now submitted to the perusal of the reader.

ARTICLE I. Ratio is the relation which one magnitude has to another, of the same kind, with respect to quantity.

II. If the first of four magnitudes has the same ratio to the second that the third has to the fourth, the four magnitudes are said to be proportionals; and, on the contrary, if it be allowed that four magnitudes are proportionals, it is understood that the first has the same ratio to the second that the third has to the fourth. In either of the two cases it is implied that the first is exactly as great when compared to the second, as the third is when compared to the fourth.

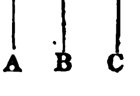
III. If the first of four magnitudes be greater, when compared to the second, than the third is when compared to the fourth, the first is said to have to the second a greater ratio than the third has to the fourth.

IV. If the first of four magnitudes be less, when compared to the second, than the third is when compared to the fourth, the first is said to have to the second a less ratio than the third has to the fourth.

V. If the first of four magnitudes has to the second the same ratio which the third has to the fourth; then if the first be equal to the second, the third is equal to the fourth; if greater, greater, if less, less. For let A be the first, B the second, C the third, and D the fourth of the four magnitudes, and first, let A be equal to B. Then as, by hypothesis, it is exactly as great when compared to B, as C is when compared to D; and as A is equal to B, it is evident that C must be equal to D. Secondly, let A be greater than B. Then, as A is exactly as great when compared to B, by hypothesis, as C is when compared to D, and as A is greater than B, C must be greater than D. Lastly, let A be less than B. Then, as A, by hypothesis, is exactly as great when compared to B, as C is when compared to D, and as A is less than B, C must be less than D.

VI. If the first of four magnitudes has the same ratio to the second which the third has to the fourth, and if any equimultiples whatever be taken of the first and third, and also any whatever of the second and fourth; the multiple of the first will have the same ratio to the multiple of the second, that the multiple of the third has to the multiple of the fourth.

Let A the first have to B the second, the same ratio that C the third has to D the fourth; and let EG be any equimultiples whatever of A and C, and FH any whatever of B and D; and then E will have the same ratio to F, that G has to H.



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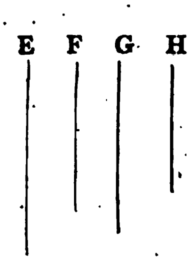
* The Editor has been indebted for this valuable article to the Rev. Abraham Robertson, D.D. F.R.S. and Savilian Professor of Astronomy, Oxford.

† See Dr. Hutton's Mathematical and Philosophical Dictionary, under the word RATIO.

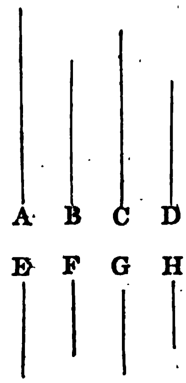
‡ Dr. Barrow, in the 21st, 22d, and 23d of his Mathematical Lectures, gives a statement of opinions concerning this fifth definition, and endeavours to defend it against all objections.



For as, by hypothesis, A is exactly as great, when compared to B, as C is when compared to D, it is evident that the double, triple, or any multiple of A, will be exactly as great when compared to B, as the double, triple, or the same multiple of C, when compared to D; and, therefore, E is exactly as great when compared to B, as G is when compared to D. From this it follows, that E is exactly as great when compared to the double, triple, or any multiple of B, as G is when compared to the double, triple, or the same multiple of D. Consequently, E is exactly as great when compared to F, as G is when compared to H; or E has the same ratio to F that G has to H.

VII. If the first of four magnitudes has to the second, the same ratio that the third has to the fourth, and if any like aliquot parts whatever be taken of the first and third, and any like aliquot parts whatever of the second and fourth; the part of the first will have the same ratio to the part of the second, that the part of the third has to the part of the fourth.

Let A the first have to B the second, the same ratio that C the third has to D the fourth; and let E, G be any aliquot parts whatever of A and C, and F, H any whatever of B, D; and then E will have the same ratio to F that G has to H.



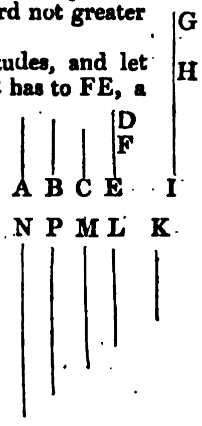
For A being exactly as great when compared to B, as C is when compared to D, it is evident that the half, third, or any aliquot part of A, will be exactly as great when compared to B, as the half, third, or the same aliquot part of C is when compared to D. But E, G are alike aliquot parts of A, C, and, therefore, E has the same ratio to B that G has to D. Again, as E is exactly as great when compared to B, as G is when compared to D; it is evident that E must be exactly as great when compared to the half, third, or any aliquot part of B, as G is when compared to the half, third, or the same aliquot part of D. But F, H are like aliquot parts of B, D, and, therefore, E is exactly as great when compared to F, as G is when compared to H; and E has the same ratio to F, that G has to H.

Remark. The preceding articles contain the attempt to attain the first of the three objects already mentioned. The sixth article is the 4th Proposition in the 5th Book of Euclid, and by the same mode of reasoning as is employed in that article, the 7th, 8th, 9th, 10th, 11th, 13th, 14th and 15th Propositions in the 5th Book may be demonstrated, as also Simson's Propositions A, B, C, D. We now proceed to the second object, or the demonstration of the 5th Definition.

VIII. If the first of four magnitudes has the same ratio to the second that the third has to the fourth, and if any equimultiples whatever be taken of the first and third, and also any whatever of the second and fourth; if the multiple of the first be equal to the multiple of the second, the multiple of the third will be equal to the multiple of the fourth; if greater, greater; if less, less. For, by article 6, the multiples will be proportionals, and, therefore, the assertion is true, by article 5.

The same things being allowed as above, it evidently follows, that if the multiple of the third be greater than the multiple of the fourth, the multiple of the first will be greater than the multiple of the second; and if the multiple of the third be less than the multiple of the fourth, the multiple of the first will be less than the multiple of the second.

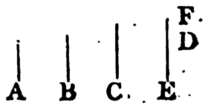
IX. If the first of four magnitudes has the same ratio to the second that the third has to a magnitude less than the fourth, then it is possible to take certain equimultiples of the first and third, and certain equimultiples of the second and fourth; such, that the multiple of the first shall be greater than the multiple of the second, but the multiple of the third not greater than the multiple of the fourth.



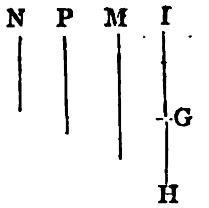
Let A, B, C, DE be four magnitudes, and let A have the same ratio to B that C has to FE, a magnitude less than DE; then it is possible to take certain equimultiples of A, C, and certain equimultiples of B, DE, such, that the multiple of A shall be greater than the multiple of B, but the multiple of C not greater than the multiple of DE.

Of DF, FE, take such equimultiples GH, HI, that each of them may be greater than C. Then of C take H the double, L the triple, &c. until a multiple of C be obtained greater than HI. Let M be the multiple of C, which first becomes greater than HI, and L the multiple of C, which is next less than M, and then HI is not less than L. But, by the construction, GH is greater than C; and as M is equal to L and C together, M is greater than HI, but not greater than GI. Let N be the same multiple of A that M is of C, and P the same multiple of B that HI is of FE; and then, as A, B, C, FE are proportionals, and as M is greater than HI, N is greater than P, by article 8. Again, as GH, HI, are equimultiples of DF, FE, by the first proposition in the 5th book of Euclid, GI is the same multiple of DE that HI is of FE, or that P is of B. Consequently, certain equimultiples, N, M, have been taken of A the first and C the third; and certain equimultiples, P and GI, of B the second and DE the fourth; such, that N is greater than P, but M is not greater than GI.

X. If the first of four magnitudes has the same ratio to the second, that the third has to a magnitude greater than the fourth; then certain equimultiples can be taken of the first and third, and certain equimultiples of the second and fourth; such, that the multiple of the first shall be less than the multiple of the second; but the multiple of the third not less than the multiple of the fourth.



Let A, B, C, DE be four magnitudes, and let A the first have the same ratio to B the second, that C the third has to FE a magnitude greater than DE; then it is possible to take certain equimultiples of A and C, and certain equimultiples of B and DE; such, that the multiple of A shall be less than the multiple of B; but the multiple of C not less than the multiple of DE.



For of ED, DF, let IG, GH, be taken, such equimultiples, that each of them may be greater than C; and, as in the last article, let M be taken, such a multiple of C, that it may be greater than IG, but less than IH. By Prop. 1. in the 5th book of Euclid, IH, IG, are equimultiples of FE, DE, and therefore let P be taken, the same multiple of B that either of them is of its part; and let N be the same multiple of A that M is of C. Then, as A B, C, FE, are proportionals, and as M is less than IH, N is less than P, by article 8. Consequently N, the multiple of A the first, is less than P, the multiple of B the second; but M, the multiple of C the third, is not less than IG, the multiple of DE the fourth.

XI. If any equimultiples whatever be taken of the first and third of four magnitudes, and any equimultiples whatever of the second and fourth; and if, when the multiple of the first is less than that of the second, the multiple of the third is also less than that of the fourth; or, if when the multiple of the first is equal to that of the second, the multiple of the third is also equal to that of the fourth; or, if when the multiple of the first is greater than that of the second, the multiple of the third is also greater than that of the fourth; then, the first of the four magnitudes will have the same ratio to the second, that the third has to the fourth.

For, if the first have not the same ratio to the second, that the third has to the fourth, it will have to the second, the same ratio that the third has to a magnitude, either greater or less than the fourth. But if the first have the same ratio to the second, that the third has to a magnitude greater than the fourth, then, by article 10, certain equimultiples can be taken of the first and third, and certain equimultiples of the second and fourth, such, that the multiple of the first shall be less than the multiple of the second, but the multiple of the third not less than the multiple of the fourth; and this would be contrary to the first of the above suppositions.

Again, if the first has the same ratio to the second, that the third has to a magnitude less than the fourth, then, by article 9, certain equimultiples can be taken of the first and third, and certain equimultiples of the second and fourth; such, that the multiple of the first shall be greater than the multiple of the second, but the multiple of the third not greater than the multiple of the fourth; and this would be contrary to the last of the three suppositions.

Lastly, if the multiple of the first be equal to the multiple of the second, and the multiple of the third to the multiple of the fourth, then the multiple of the first will have the same ratio to that of the second, that the multiple of the third has to that of the fourth; and consequently, by article 7, the first will have the same ratio to the second, that the third has to the fourth.

Remark.—The fifth definition of the 5th book of Euclid, having been considered as a proposition, and established as such by demonstration, the doctrine of ratio and proportion may be extended as in that book. The same extension, however, may be effected by means of the first seven of the preceding articles, as a foundation connected with this evident truth, that two magnitudes of the same kind must have the same ratio to one another, as the numbers which measure them, or express their relative values. Whatever is proved as to the proportionality of the numbers, must be applicable to the magnitudes to which they are strictly analogous.

XII. If four numbers be proportionals, the product of the first and fourth is equal to the product of the second and third. Thus if N, P, M, Q, be four numbers, and if it be N : P :: M : Q, then N × Q = P × M. For dividing the first and third of the proportionals by N, and the second and fourth by P, we have according to article 7, $1 : 1 :: \frac{M}{N} : \frac{Q}{P}$, and therefore, by article 5, $\frac{M}{N} = \frac{Q}{P}$, and N × Q = P × M.

XIII. If there be four numbers, such that the product of the first and fourth is equal to the product of the second and third, the first has the same ratio to the second, that the third has to the fourth. Thus, if N, P, M, Q, be four numbers, and if N × Q = P × M, then N : P :: M : Q. For, let R be a fourth proportional number to N, P, M; and then, by the last article, N × R = P × M. But, by hypothesis, P × M = N × Q; and therefore N × Q = N × R. Consequently, N : P :: M : Q.

In the following articles, let the small letters, *a*, *b*, *c*, &c. denote the numbers which express the relative values of the magnitudes A, B, C, &c., and then the subsequent explanation applies to them all. The large letters are used in the data and assertions, the demonstrations are effected by the small letters, and the large are put instead of the small in the conclusion, thereby intimating that the assertion has been proved.

XIV. If four magnitudes of the same kind be proportionals, they will also be proportionals when taken alternately. Thus, if it be A : B :: C : D, then A : C :: B : D.

For it being $a : b :: c : d$, by article 12, $a \times d = b \times c$; and therefore, by article 13, $a : c :: b : d$, that is A : C :: B : D.

XV. Ratios that are equal to the same ratio, are equal to one another. That is, if it be A : B :: C : D, and C : D :: E : F, then A : B :: E : F. For it being $a : b :: c : d$, and $c : d :: e : f$, by article 12, $a \times d = b \times c$, and therefore $\frac{a \times d}{b} = c$, and $\frac{a}{b} = \frac{c}{d}$. For the same reasons, $\frac{c}{d} = \frac{e}{f}$, and consequently, $\frac{a}{b} = \frac{e}{f}$, and $a \times f = b \times e$, and by article 13, $a : b :: e : f$. Hence, A : B :: E : F.

XVI. If any number of magnitudes be proportionals, any one of the antecedents has the same ratio to its consequent, that all the antecedents, taken together, have to all the consequents taken together. That is, if it be A : B :: C : D, and C : D :: E : F, then A : B :: A + C + E : B + D + F. For it being $a : b :: c : d$, and $c : d :: e : f$, by the last article, $a : b :: e : f$. By article 12, therefore, we have $a \times d = b \times c$, and $a \times f = b \times e$, and consequently $a \times d + a \times f = b \times c + b \times e$. To these equals add $a \times b$, and then $a \times b + a \times d + a \times f = b \times a + b \times c + b \times e$, or $a \times (b + d + f) = b \times (a + c + e)$. Consequently, by article 13, $a : b :: a + c + e : b + d + f$; that is, A : B :: A + C + E : B + D + F.

XVII. If of four magnitudes the first and second together have the same ratio to the second, that the third and fourth together have to the fourth; the first will have the same ratio to the second that the third has to the fourth. That is, if it be $A+B:B::C+D:D$, then $A:B::C:D$. For it being $a+b:b::c+d:d$, by article 12, $a\times d+b\times d=b\times c+b\times d$. Consequently $a\times d=b\times c$, and by article 13, $a:b::c:d$, and therefore $A:B::C:D$.

XVIII. If the first of four magnitudes has the same ratio to the second that the third has to the fourth, then the first and second together will have the same ratio to the second that the third and fourth together have to the fourth. That is, if it be $A:B::C:D$, then $A+B:B::C+D:D$. For it being $a:b::c:d$, by article 12, $a\times d=b\times c$; and $b\times d$ being added to these equals, we have $a\times d+b\times d=b\times c+b\times d$. Consequently, by article 13, $a+b:b::c+d:d$, and therefore, $A+B:B::C+D:D$.

XIX. If a whole magnitude has the same ratio to a whole that a magnitude taken from the first has to a magnitude taken from the other; the remainder will have the same ratio to the remainder that the whole has to the whole. That is, if C be a part of A, and D a part of B, and if it be $A:B::C:D$, then $A-C:B-D::A:B$. For it being $a:b::c:d$, by article 12, $a\times d=b\times c$, and these equals being subtracted from $a\times b$, we have $a\times b-a\times d=a\times b-b\times c$. Hence, by article 13, $a-c:b-d::a:b$, that is $A-C:B-D::A:B$.

If from the equals $a\times d$, $b\times c$, we take $c\times d$, we have $a\times d-c\times d=b\times c-c\times d$, and then $a-c:b-d::c:d$. That is $A-C:B-D::C:D$. This also follows from the above and article 15.

XX. If four magnitudes be proportionals, the sum of the first and second will have the same ratio to their difference that the sum of the third and fourth has to their difference. That is, if it be $A:B::C:D$, then $A+B:A-B::C+D:C-D$. For it being $a:b::c:d$, by article 12, $a\times d=b\times c$, and therefore $-a\times d+b\times c=a\times d-b\times c$. To these equals add $a\times c-b\times d$, and then $a\times c-a\times d+b\times c-b\times d=a\times c+a\times d-b\times c-b\times d$, or $(a+b)\times(c-d)=(a-b)\times(c+d.)$ Hence, by article 13, $a+b:a-b::c+d:c-d$, and therefore $A+B:A-B::C+D:C-D$.

XXI. If there be any number of magnitudes, and as many others, which, taken two and two in order, have the same ratio; the first will have to the last of the first magnitudes, the same ratio which the first of the others has to the last. First let there be three magnitudes, A, B, C, and other three, D, E, F, and let it be $A:B:D::E$, and $B:C::E:F$, and then it will be $A:C::D:F$. For, as $a:b::d:e$, and $b:c::e:f$, by article 12, $a\times e=b\times d$, and $b\times f=c\times e$, and therefore $\frac{a\times e}{c\times e}=\frac{b\times d}{b\times f}$, and $\frac{a}{c}=\frac{d}{b}$, or $a\times f=c\times d$. Hence, by article 13, $a:c::d:f$; that is, $A:C::D:F$.

Again, let there be four magnitudes, A, B, C, G, and other four, D, E, F, H, and let it be $A:B::D:E$, $B:C::E:F$, and $C:G::F:H$, and then it will be $A:G::D:H$. For by the above $A:C::D:F$, and by what is now allowed $C:G::F:H$. Consequently, by the first case again, $A:G::D:H$; and in the same manner the demonstration may be extended to any number of magnitudes.

XXII. If there be any number of magnitudes, and as many others, which taken two and two in a cross order, have the same ratio; the first will have to the last of the first magnitudes the same ratio which the first of the others has to the last. First let there be three magnitudes, A, B, C, and other three, D, E, F, and let it be $A:B::E:F$, and $B:C::D:E$, and then it will be $A:C::D:F$. For as it is $a:b::e:f$, and $e:b::c:d$ by article 12, $a\times f=b\times e$, and $b\times e=c\times d$, and therefore $a\times f=c\times d$. Hence, by article 13, $a:c::d:f$; that is $A:C::D:F$.

Again, let thore be four magnitudes, A, B, C, G, and other four, H, D, E, F; and let it be $A:B::E:F$, $B:C::D:E$, and $C:G::H:D$, and then it will be $A:G::H:F$. For as in the preceding case, $A:C::D:F$, and therefore, again, by the first case, $A:G::H:F$, and in this way the demonstration may be extended to any number of magnitudes.

By the method employed in the foregoing articles, the doctrine of ratios may be easily extended.

RATISBON or REGENSBURG, an ancient city of Germany, in the kingdom of Bavaria, is situated on the south bank of the Danube, opposite to the mouth of the river Regen. It is large and populous, and built of stone, but the streets are crooked and narrow, and the houses lofty and old-fashioned. The cathedral, which is one of the best of its public buildings, is a large Gothic edifice, built in 1400. The church and abbey of St. Emmeran, which is like a small town, contains some good paintings, and also a mathematical and physical cabinet. The town-house is an old and uninteresting building. Besides these buildings, we may enumerate the palace of the Prince of Tourand Taxis, in which there is a good library open to the public; the church of the Trinity, the Scottish church and convent, and its library; the building of the Jesuits' College, the arsenal, and the Haidplatz. There are also several hospitals in Ratisbon, two public libraries, a botanical society, and a public drawing-school. A bridge over the Danube, of fifteen arches and 1091 feet long, forms a communication between the city and the suburb of Stadt-am-hof.

Ratisbon has few manufactures, and very little trade. The principal manufactures are those of linens, lace, silk and worsted stockings, and needles. The fire-arms of Kugelreuth, particularly his pistols, are greatly admired. Wood, provisions, corn, and salt are sent down the Danube to Vienna. There are several breweries and distilleries in the town, and dockyards for building boats and small craft. There are also here some saw-mills driven by water. The hydromel of Ratisbon is in great request, and a considerable quantity of it is exported. The two annual fairs of St. George and St. Michael are well attended. The chief promenades are, the alley of the Prince of Taxis, the high and the low Weorth, and the Lime Trees. The inhabitants, who are principally Catholics, are computed at 24,000. East Long. 12° 4′ 30″. North Lat. 49° 0′ 53″.

RATZEBURG, a town of Denmark, in the duchy of Lauenburg, and situated on an island in a lake of the same name. The lake is about thirty miles long, and nine broad, and communicates with the continent on the east by a bridge, and on the west by a dike. The streets of the town are regularly laid out, and the houses are built in the Dutch fashion. The Regency Office, where the court of justice and the consistory are held, stands in the market place; and the cathedral deserves to be visited.

The principality of Ratzeburg, between Mecklenburg and Saxe-Lauenburg, contains about 136 square miles, and 14,000 inhabitants, and is traversed by the river Trave. The soil is fertile, producing much wheat, and pasturing many cattle. It was once a bishopric, but was secularised at the peace of 1648. Every week two coches d'eau set out for Lubeck. Population of the town about 2000. East long. 10° 46′, north lat. 53° 43′.

RAVENGLASS, a seaport and market town of England, in the county of Cumberland, is situated on the Solway Frith, near the conflux of the rivers Esk, Mite, and Irt. The town is tolerably well built, and the harbour commodious, but it is chiefly supported by the oyster fishery.

Near the town are the ruins of the *city of Barnscar*, said to have been founded by the Danes. The figure of it is an oblong square, and its circuit about three miles. There seems to have been a long street with several cross ones. The remains of the house-steads within the walls are not very numerous, but those on the outside are said to be innumerable, particularly at the south side and west end. See Hutchinson's *History of Cumberland and the Beauties of England and Wales*, vol. iii. p. 230.

RAVENNA, an ancient city of Italy, in the states of the Church, is situated on the river Mentone, near the Adriatic. Although the streets are tolerably straight and spacious, yet the town has a gloomy and ruinous aspect. The principal public building is the Cathedral, which is modern, and has its nave sustained by four rows of columns, of Greek marble. The church of St. Vitale, which has the shape of an octagon, is likewise supported by columns of Greek marble, and contains various objects of antiquity. The church called the Rotonda, without the town, was built by Amalasanda, in honour of her father Theodoric, king of the Ostrogoths. Besides these and some other churches, there are twenty-four convents in Ravenna.

Among the antiquities of Ravenna, we may enumerate the Porta Aurea, a fine marble gate, built by the Romans; and the palace of Theodoric. The mausoleum of this sovereign is still to be seen, covered with a stone twenty-eight feet in diameter, and fifteen feet thick. Mosaics, basso-relievos, and different pieces of sculpture occur in various parts of the city. Ravenna contains also the tomb of the celebrated Dante.

In the time of the Romans, this city stood in a sort of bay, formed by the Adriatic, and had the advantage of a good harbour. The port, however, is now filled up with the mud and sand thrown up by the tide, which has formed a tract of land of three miles in extent, which separates the town from the sea. Owing to the marshy nature of the ground, the climate of Ravenna is insalubrious, but this evil has been considerably removed, by conveying the rivers Mentone and Ronco along the skirts of the city, for the purpose of carrying off the stagnant waters from the marshy grounds. Ravenna has no fortification, but is encircled with a mound.

A Roman colony is said to have been established in this city by Augustus. Tiberius repaired its walls, Trajan erected a fine aqueduct. Honorius and Octavius made it successively the place of their residence; and Theodoric having fixed the seat of his empire in this city, endowed it with fine churches and palaces.

Population, about 12,000. East lon. 12° 10′ 51″ and North lat. 44° 25′ 5″

RAY, John. See our article Botany, Vol. IV. p. 11—13. for a full account of the life and botanical labours of that eminent naturalist.

RAYNAL, William Francis, a celebrated French historian, was born at St. Genies, in the Rovergue, in the year 1713. At an early age he entered the society of the Jesuits, and was ordained priest; but he quitted that body in the year 1748, and began the career of a professional author. In 1748 he published his *Histoire du Stadthouderat*, which was followed by his *Histoire du Parlement D'Angletèrre*; a work which procured him considerable celebrity. He likewise composed a work entitled *Anecdotes Litéraires*, in 3 vols. 12mo.; the *Mémoires de Ninon de l'Enclos*, and various smaller pieces, in the *Mercure de France*.

In consequence of finding that his literary pursuits were not very profitable, he entered into some commercial speculations, which led him to those studies which terminated in the composition of his great work entitled “*Histoire Philosophique et Politique des Etablissemens et du Commerce des Européens dans les deux Indes*; which appeared in the year 1770. This work at first excited considerable interest. One party was pleased with the spirit of philosophy and liberty which it breathed, and regarded its author as a bold reformer of the abuses of the age in which he lived; while the critics of another party condemned both the style and the principles of the work, and cast a doubt even on the facts and documents on which the reasonings of the author were founded.

Sensible of the numerous imperfections of his work, the Abbé himself resolved to improve it by foreign travel; and he accordingly visited the principal commercial towns in France, England, and Holland, and collected much useful information from the travellers and mercantile men with whom he happened to associate. Upon his return he corrected and enlarged his work, and published it at Geneva, in 10 vols. 8vo. Although the work was greatly improved, yet its general tone was the same; and so bold were its aspersions upon existing authorities, that the parliament of Paris ordered it to be burnt, and issued a decree for apprehending Raynal. Under these circumstances he retired to Spa; and, after having made a tour through Germany, and visited most of its principal towns, he ventured to return to France, and lived unmolested in the southern provinces.

The war between America and the mother country having excited general attention in Europe, the Abbé Raynal published, in 1781, his *Tableau et Révolutions des Colonies Angloises dans l'Amérique Septentrionale.* When the French revolution was about to burst forth, the Abbé came to Paris in 1788; and one of the first acts of the National Assembly was to abrogate the decree which had been issued against him by the parliament. The violent and unjust proceedings which afterwards took place in Paris induced our author to publish, in May 1791, a long letter of advice and remonstrance, in which he points out the errors and licentiousness of the people, reminds them of the eternal obligations of religion, the laws, and the royal authority, and endeavours to prove that it was not the business or the right of the Assembly to abolish ancient institutions, and *that the genius of the French people is such, that they cannot be happy or prosperous but under a well-regulated monarchical government.* These remonstrances excited little notice, and the author retired to Passy; where he died in a state of great indigence, in March 1794, in the 85th year of his age. The Abbé Raynal wrote a *History of the Divorce of Catharine of Arragon by Henry VIII.* and a *History of the Revocation of the Edict of Nantz.* See Marmontel's *Memoirs*, for some anecdotes of Raynal.

READING, a borough and market town of England in Berkshire, is situated on two small eminences on the river Kennet, which flows through the town in several channels. The streets are in general regular, though some of them are narrow; and the houses, which are good, are built of brick.

The principal public buildings and establishments are the three parish churches of St. Lawrence, St. Mary's, and St. Giles; several meeting houses belonging to the dissenters, the town hall, the theatre, the county gaol, and various schools. The church of St. Lawrence, built about the end of the sixteenth century, is partly built of the materials of the old abbey. St. Mary's church, the tesselated tower of which is admired, was built about 1547, and part of it seems to have belonged to a more ancient edifice. St. Giles's church, which was probably built about the end of the twelfth century, has a modern tower, the old one having been damaged by the cannon of the parliamentary army in 1643. The dissenting meeting houses are those of the Independents, the Baptists, the Quakers, the Methodist, besides a Cudworthian, and a Unitarian meeting house, and a Catholic chapel.

The town hall and free school form one neat building; the latter being on the ground floor, and the former on the upper story. Among the portraits in the council chamber, there is a good likeness of Queen Elizabeth. The county gaol was erected in 1793, on the site of one of the ruins of the abbey. It is a large and commodious building, with a neat chapel, an infirmary, &c. in the centre; while one of the wings is allotted to males, and the other to female prisoners. The theatre, which has been recently built, is commodious and neat. The bridewell was once a priory, and the west window of it is handsome.

The free school of Reading was established by the abbot John Thorne, in the time of Henry VII. The Blue Coat School was founded in 1656, by Mr. Richard Aldworth, who left £4000 for the support of a master, lecturer, and twenty boys; but in consequence of other donations, it is able to support forty-eight boys. The Green School, for the daughters of decayed tradesmen, and of unprovided orphans, is supported by annual subscription. In the Foundation School, instituted in 1766, by Mr. Joseph Reid, eight male, and eighteen female children are taught to read. The School of Industry for female children, is supported by subscriptions from ladies. The Lancastrian School, established in 1818, educates thirty-two boys nominated by the subscribers. The school for national education on Dr. Bell's plan was founded in 1813.

There is also in Reading a public library, a dispensary, a workhouse for the employment of the poor, called the Oracle, established in 1624, by Mr. Hendrick's legacy of £7500, and occupied by sacking manufacturers, sail-cloth weavers, and pin-makers, &c.

Among the antiquities of Reading, the principal are the ruins of the abbey, which was founded by Henry I. in 1121. These ruins consist of fragments of massy walls of flint and gravel, which are in some places eight feet thick, and which seem to have been once cased with stone. The space which it occupied measured about thirty acres, and was surrounded on three sides by a high and strong wall, and on the fourth by the river Kennet. The abbey church seems to have been 260 feet long, and to have had the form of the cross with the tower and spire in the centre. The abbey mill is still standing, and in actual use: it is a substantial building of flint and stone, and seems to be of the same age with the abbey church.

The borough of Reading was incorporated by charter from Queen Elizabeth, who also conferred upon the corporation considerable estates. It is governed by a mayor, a recorder, twelve aldermen, and twelve burgesses. It sends two members to parliament, who are elected by the inhabitants, who pay scot and lot, about 800 in number.

The situation of Reading is very favourable for trade. By the Thames, it has an easy communication with the metropolis; and as the Kennet is navigable westwards to Newbury, a communication is opened with Bath, Bristol, and the Severn, by means of the Kennet and Avon canal. The principal articles which are exported from Reading are flour, 20,000 casks of which are annually sent to London, timber, bark, straight hoops, linen, wool, cheese, &c.

The articles of import are groceries, iron, spirits, fir timber, deals, staves, Portland stone, bricks, hemp, flax, hides, leather, coals, Bath freestone, Birmingham goods, &c. &c. Reading was formerly celebrated for its extensive trade in woollen goods, but it declined in the seventeenth century, and has never revived. The principal manufactures now are sail-cloth, floorcloth, sacking, gauze, crapes, muslinets, ribbons, hatbands, shoe-strings, and pins. Reading has two weekly markets, one on Wednesday for butcher meat, fruit, vegetables, &c. and one on Saturday for corn, cattle, pigs, and various articles of provision. Population about 12,000. West Long. 0° 38'. North Lat. 51° 27'. See the *Beauties of England and Wales*, Vol. i. p. 83, but particularly the *History and Antiquities of Reading*, by John Mann, 4to. 1817.

REALGAR. See Mineralogy *Index*.

REAPING MACHINE, is a machine intended to be used for cutting down standing corn.

In our article on Agriculture, Vol. I. p. 263, we have already given a chapter on machines for reaping corn; but as the subject was then in its infancy, we promised to renew the consideration of it under the present head. We shall therefore lay before the reader a description of Mr. Scott's ingenious machine, which we have no doubt will yet come into actual use, and also an improved form of Mr. Gladstone's reaping machine.

1. *Description of Mr. Scott's Reaping Machine.*

Description of Mr. Scott's reaping machine. Plate CCCCLXXVIII. and CCCCLXXIX. Figs. 1, 2, 3, 4.

Plate CCCCLXXVIII. Fig. 1. represents the under frame part of the reaping machine; this part supports Fig. 2. on four strong iron pillars, two of them are similar to Fig. A, the other two to Fig. B, into the last mentioned two, a strong iron axis x is immoveably fixed, on which turn the two roller wheels C and D, that carry the machine, as shown by Figs. 1. 3. and 4.

Fig. 5. represents the cutter ring, on which are screwed sixteen cutters, all toothed similar to that of a common reaping hook; these cutters are made to cut the corn, against the front prongs, at the angle of 45°. The form of the prongs to effect this is shown in Fig. 1. of which they form a part, as also in Figs. 3. and 5.

The upper frame part of the cutter rings is represented by Fig. 6. and is fixed to it by four strong iron pillars similar to Fig. E.

Fig. 4. is a section of the whole machine, where $a\ b\ c\ c$ represents the under frame part, as shown by Fig. 1. $e\ f$, the frame ring as shown by Fig. 2. $e\ b$ and $f\ c$ the two pillars, as represented by Fig. B, which connect this ring with the under frame part, and into these two pillars is fixed the strong iron axis x. C and

Plate CCCCLXXVIII. and CCCCLXXIX.

D are the two roller wheels on which the machine moves. *z z* is the cutter ring, as shown by Fig. 5. *z y* and *z y* are two of the pillars, similar to Fig. E, which connect the upper frame part of *y y*, Fig. 6, to the cutter ring Fig. 5. *d d d d* is a drum made of thin rolled plate iron, supported by six arms, two of them, *r* and *s*, only appear in the section, each of these arms have T, ends, for the better fixing of the drum, and it was strengthened by hoops of iron at both ends, this drum carries twenty-four collectors, similar to Fig. 7, that play in eyed studs, see Fig. 12.

On the inside of the roller wheel C is fixed a ring level wheel *u u* of forty-eight teeth, which turns the level wheel 1, of twenty-four teeth; on the same axis with the wheel 1, are two wheels fixed on a hollow axis, but which play freely on the axis of the wheel 1, the uppermost of these two wheels, marked 2, has twenty-five teeth that act in the teeth of the wheel 3, of twenty teeth; the small wheel 4, of ten teeth, turns the wheel 5 of thirty teeth; on the top of the axis of the wheel 5 are fixed the arms that carry the drum; on the top of the hollow axis of the wheel 3, is fixed a flange that is firmly bolted to the upper part of the frame of the cutter-ring. The under end of the axis of the wheels 1, 2, and 4, plays in a brass socket in the great axis, and the upper end in a bushed hole *o*, in one of the arms of Fig. 2, and *e f* Fig. 4.

The hollow axis of the wheel 3 of 20 teeth, plays in a deep brass bush fixed into the centre of the upper frame ring Fig. 2, and *e f* Fig. 4, and the under end of the axis of the wheels 3 and 5 plays in a bushed socket in the great axis, and can be adjusted by the screw 9, Fig 4.

There are two stubs on the under side of the wheel 1, and other two on the upper side of the wheel 2; the stubs of the wheels 1 and 2 can be brought into contact or disengaged at pleasure, by means of the lever L, Fig. 3, that pushes in or draws out a kind of slit wedge on an inclined part in the great axis, immediately below the wheel 4, having its inclination contrary to that of the wedge; when the lever L is put into the notch *m*, the roller wheel C will put the machinery in motion, and when it is put into the notch *n*, the machine may be moved forward and the machinery remain at rest.

In the section Fig. 4, one of the front prongs is shown, which could not otherwise be represented with regard to the position of the roller wheels: on each of the front prongs is fixed a piece of hard wood, to which are screwed two thin iron prongs *k*, placed at the best angle for pressing the root end of the cut corn into the collectors, as also out of the way of the corn to be cut.

Fig. 3. is a plan of the machine, where C and D represent the roller wheels; *u u* the ring level wheel that is fixed to the inside of the roller C; the circles 1, 2, 4, 3, and 5, represent the wheel work as shown in the section Fig. 4: *e f* the upper ring that is supported by the under frame part: *y y* the ring that carries the cutter circle; *t u v w*, a deep ring of hoop iron that serves to work the collector hooks out and in, through holes cut for each collecting hook in the thin plate iron drum *d d d d*; each collector axis has two tails, one of them hinged, and the other fixed, the hinged or jointed tail, is represented at *x* Fig. 7, and the mortice for the fixed tail at *z*. The ring *t u v w* has two long slits, the one from *v* by *u* to *t*, which the tails *x x x*, &c. pass through when on that part of the ring, the other slit is cut from *v* by *w* to *t*, which the tails *z z z*, &c. pass through, when moving round that part of the ring. At that part of the circular hoop where the tails *x x x*, &c. pass through, a groove commences formed on the outside of the hoop by means of two rods of iron rivetted at a little distance from each other on the outside of it for the tails *z z z*, &c. to travel along, while the tails *x x x*, &c. are through their slit; and where the tails *z z z*, &c. pass through the hoop, a similar groove commences on the outside of the hoop for the tails *x x x*, &c. to travel in, while those of *z z z*, &c. are travelling through their slit. When the tails *x x x*, &c. pass through their slit in the hoop, the tails *z z z*, &c. travel in their groove, by which the hooks of the collectors are thrown out so as to collect the cut corn; and when the tails *x x x*, &c. travel in their groove, the hooks of the collectors are thrown in, and the cut corn allowed to fall to the left hand in a continued swath. The curved piece *v* guides the tails *z z z*, &c. into their groove, and in like manner the curved piece *t* conducts the tails *x x x*, &c. into their groove.

Two semicircles were cut out of strong rolled plate iron, one with prongs exactly cut to correspond with the front prongs of Fig. 1. These semicircles were made truly flat by hammering, and then joined, so that the circular parts formed one circle; it was then placed upon the bottom frame with its prongs corresponding to those of the frame; the prongs of the plate iron and those of the frame were then rivetted together with rivets, as appears by the dots on the prongs Fig. 3; by this means the fore part of the plate-iron circle was kept at a proper height, for the cutters on the cutter circle to pass through between the bottom frame prongs and those of the plate iron; the hind part of this circle was supported by several kneed pieces similar to Fig. 8, the short legs being rivetted against the under side of the bottom frame, and the long legs made to support the plate iron circle, leaving space sufficient for the cutters to pass. This plate-iron circle was made of a breadth to reach into the circle *t u v w*, Fig. 3, that work the collectors; and this ring is supported by kneed pieces rivetted to it and the circular plate similar to Fig. 9, and they are so formed as to give strength to the parts of the hoop *t u v w*, where the slits are, and at the same time permit the tails of the collectors to pass through. The dotted circle, Fig. 5. shows the inside of the rolled plate-iron circle, but is only there represented as covering the front prongs.

There was fixed on the long right-hand prong P, Fig. 3, a sheet of thin plate iron, kneed to the same acute angle with the prong, and of the same height with the drum, for the purpose of dividing the standing corn from that to be cut. And there was also an inclined piece of sheet iron, &c. so placed on the left hand side of the machine as to prevent its progressive motion from carrying the root end of the corn too far forward after being cut.

G H, Fig. 3. and Fig. 10, form the draught bar by which the horse draws the machine with traces on the stubble side of the field.

Fig. 11. represents another kind of a cutter circle, which probably might have been found on trial preferable to the one that was introduced into the machine; the cutting part of it was to have been made in segments of iron faced with steel of a shape that would have admitted the whole length of their faces being struck or cut with teeth, at a proper angle, similar to those of a coarse struck reaping hook: the form of these segments are represented in the Fig. at *x x x*, &c. there were small tongues *t t t*, &c. to be formed on the cast iron part of the cutter circle of the same height with the thickness of the cutter segments, and which, with the screws shown in the figure, would have effectually prevented the segments being forced out of their places: the front prongs shown in this figure are to be supposed as those of the under frame, and which are there placed to show the form that they ought to have been made of, so that this circular cutter might have cut to the best possible advantage against each prong. The bottom prongs are there represented as covered with those of the rolled iron plate circle, as described by the other figures, and which in Fig. 11. is to be supposed to extend to the dotted circle *a b c d*, as in Figs. 3. and 5.

All the figures are drawn to a scale of twenty inches to the inch, except Fig. 12. which is drawn on a larger scale, on purpose the better to show how the collectors Fig. 3. are wrought. In Fig. 12. *t y s t* represents part of the drum, and *a b c d e* part of the hoop that works the tails of the collectors; *s* and *s* represent two of the eyed studs that are fixed into the upper and under hoops that strengthen the drum, for the pivots of the axes of the collectors to play in. *t* and *t* two of the longer studs fixed in the underhoop of the drum, for the hinged tails *x* and *z* to play in. The tail *z* is represented as moving in its groove, and the tail *v* travelling in its slit, and which is just about being directed into its groove by the curved piece *d*, when at the same time the tail *z* will enter its slit, and the hook of the collector *m* will be thrown into a position similar to that of *n*. And again the tail *u* is represented as moving in its groove, and the tail *x* in its slit, and which is about being guided into its groove by the curved piece *b*; when at the same time the tail *u* will enter its slit, and the hook of the collector *n* will be thrown into the position of *m* in the figure. Y Fig. 12. represents one of several thin brushes fixed into the under rim of the drum, made of two pieces of iron rivetted together, with a range of bristles between, for sweeping forward the root end of the cut corn, and keeping that part of the cover plate clean swept.

The reaping machine here described differs much from all those attempts that the writer of this article had any knowledge of, not only in the construction of its different parts, but also in the nature and form of its cutters and front prongs, as likewise in the method of working the machine itself.

With regard to the cutters, a variety of experiments were made with cutters of different forms, as also in the manner of applying them, when it was ascertained that the draw cut of a common reaping hook was inferior to none for cutting corn, besides having the property of seldom requiring sharpening, as is manifest from the common reaping hook, that will cut for a whole harvest without requiring sharpening. But to give toothed cutters that are fixed upon a revolving circle, the best form to act similar to a draw cut, it is necessary that they form an angle of forty-five degrees with the diameter of the revolving circle on which they are fixed; but from the variety of positions that cutters moving circularly present themselves to the corn during every revolution, no two of them can cut the corn to the same advantage, if the straight prongs that have been adopted by others were to be used; it was therefore found absolutely necessary to form that part of the front prongs against which the cutters cut the corn, in lines that formed with the cutters the angle of forty-five degrees, as represented in the figures.

With regard to working the machine: the difficulty in working a reaping machine arises from the corn that is to be cut standing in the way of the best possible line of draught, and the necessity of yoking the horse in such a manner that he shall neither tread upon the cut nor uncut corn. Trials were made on different methods, but the one that was found to be by far the most suitable, was nearly upon the principle that boats on canals are drawn by horses; the boat is kept in the middle of the canal by means of the helm, the horse is yoked to the boat by means of long traces, and walks at the distance of between three and four feet from the brink of the canal. To apply similar principles to a reaping machine, handles of sufficient length were placed behind the machine, to give a man power to keep the roller wheels upon which the machine moves at right angles to the line of the corn to be cut, so as to produce an effect similar to that of the helm upon the boat.

The horse was yoked with traces to the fore corner of the machine next to the stubble, as shown by Fig. 3, where he was at liberty to travel without treading either upon the cut or uncut corn, and exactly in a line parallel to the direct course of that point of the machine to which he was yoked, and not, as in the case of the canal boat, at several feet distance from the parallel of that line, which shows that a horse can be yoked in a more advantageous line of draught to a reaping machine than to that of a canal boat; besides, the left hand roller wheel on the side that the horse draws the machine, works all the machinery part, and therefore makes it no way difficult for the man at the handles to keep forward the right hand roller wheel, it being at liberty to turn freely upon its axis.

As to the smith work of the machine, a great error was committed in making the under frame part that supported the whole machinery of too slender a bar of malleable iron, and which had to be formed into a circular ring the flat way; for by the great number of heats that it received in the blacksmith's fire before he could bring it nearly to a circular form, he reduced it much in strength, and it was further reduced by filing and grinding before the blacksmith could make it into a truly flat and circular ring; and of necessity it had, after all, to be pierced with a number of holes for the pillars, &c. &c. so that when loaded with the weight of the machine, it vibrated much, even when travelling along a smooth even surface. A similar error was also committed in making the cutter circle of too thin malleable iron, for which reason the figures of these parts are here drawn to represent cast iron circles, as all the other circles of the machine were. With respect to the other parts of the machine, they acted up to expectation.

The only uncut corn that was in the immediate neighbourhood of the machine, was that of a small corner of coarse new broken up lea ground, sown for the first time with oats, of about thirty yards in length.

The first trial of the machine was made in presence of several spectators, on the side of the plot that appeared to have the evenest surface, when the machine cut and collected, in a very neat manner, the length of the plot, not leaving behind it a single uncollected straw, and laid down the cut corn into a regular continued swath, nearly at right angles to the line that the horse travelled in. By the machine cutting in this manner thirty yards in length, was evidently shown the practicability of making a machine to cut a much greater extent, as also free from all the defects here mentioned.

The next trial of the machine was discouraging to those that could make no allowance for the slenderness of the bottom frame, which ought to have been thrice the strength that it was made of.

The piece of ground that the second trial was made on, was much more uneven than we were aware of; for the unrotten rushy sward was found to be nearly as the plough had left it, the horse having only moved forward for a short way, when the roller wheels sunk into a deep unobserved hollow, and the exertions of the horse made the bottom part of the frame bend so much up, as caused the cutters to act against the cover plate with such force, that one of the cutters cut an inch and a quarter into it, another at the same time three-fourths of an inch, and a third nearly half an inch, which was a sufficient proof of the power of the machine, but, at the same time, more than a sufficient proof of the weakness of the bottom frame part.

Several private trials were afterwards made with the machine, but it is unnecessary to give any other report of them, than that the great defect in the strength of the bottom frame part was manifest in them all.

2. *Mr. Gladstone's Improved Reaping Machine.*

Mr. Gladstone's Improved Reaping Machine.

In our article on Agriculture, we have given a full description, accompanied by a drawing, of the first reaping machine, invented and constructed by Mr. Gladstone, an ingenious millwright at Castle Douglas. In putting that machine, however, to actual trial, Mr. Gladstone found, that as the teeth for gathering the corn were on the upper side of the cutter, they never could get quit of the cut corn. The machine cut a yard's length with great perfection, but the corn after this stuck in the teeth, so that the growing corn was shoved forward, and the cutter went over the top of it. He was therefore led to remedy this evil, by the construction which we shall proceed to describe.

Plate CCCCLXXXIX.

This reaping machine is wrought by one horse, and is represented in Plate CCCCLXXXIX. Fig. 13. is a view from the side of the machine farthest from the growing corn. A represents the shafts for the horse like those of a common cart, B a diagonal piece of wood as shown at B in Fig. 19, for the purpose of strengthening the frame. G is the wheel carrying the one side of the machine, and giving motion to the gatherer, by means of a pinion working into a wheel fixed on the gatherer at H on Fig. 19, at M in Fig. 18. K is a block of wood or bolster for supporting the axle of the wheel G, and LLLL is the gatherer moving round the common centre N, and having the form of a cylinder of thin boards with teeth starting out from holes at the side where the corn is cut, and put back again within the cylinder as at Fig. 15. P is a small wheel carrying the principal part of the machine, with segments of cast-iron on it acting on the pinion on the socket of the cutter, as at Fig. 14. Q represents teeth of wood for gathering up the straggled corn, and holding it or preparing it for the cutter, as at Fig. 19. Fig. 14. is a view of the cutter by itself, having a socket of cast-iron, with a pinion upon the socket about two inches in diameter, to take into the upright bar, Fig. 17, which is the centre bar, and is acted upon by the wheel P, whose motion is obtained from the surface of the ground and the weight of the machine. The cutter has four iron arms screwed into the last socket at the top. and bent as at RR, on purpose to allow the teeth of the gatherer to pass when thrown in by the circular pin of wood, as at Fig. 19, and the cutters are in six pieces and bolted to a bar of iron at SS, to which the arms are bolted likewise. Fig. 15. is a view of the gatherer by itself, only the circular bars to put out and in the teeth of the gatherer, as the gatherer comes round. As the teeth and cross on the top are all fixed on one piece, when the gatherer comes round the end of the cross at T will strike the circular bar V, and by that means send out the teeth to catch the corn at W, and the other pieces of circular wood at X will send in the teeth to the straight of the cylinder, and thus drop the corn without scattering any of it. This gatherer is made of two slender wooden rings, and is covered on the outside with thin boards, with a socket of cast or malleable iron to turn on the bar V. The cutter and gatherer are both fixed on the same bar. Fig. 16. is a view of the teeth of the gatherer by itself. Fig. 17. is a view of the centre bar, the top part of which is square fitted into the frame, a plate of iron being on the under, and another on the upper side, the middle being round turned and smooth for the cutter and gatherer acting upon the bottom part square like the top, only the square is taken from the round, so that the sockets may go on. On the bottom square is fitted a piece of iron, either cast or malleable. The cast iron is no doubt cheaper; but malleable iron is better. Its use is to fix the teeth for gathering the corn, and likewise for the centre of the centre wheel for carrying the machine, as at P in both Fig. 18, and 19. Fig. 18. is a view of the machine behind, showing how the cutter and gatherer pass one another, and how the teeth are fixed that gather up the loose corn. Fig. 19. is a view from the top of the machine, showing the framing and top of the gatherer, part of the cutter, and gathering teeth.

When the machine was thus constructed, it was subjected to trial, and it was found to have no tendency to choak, but kept itself clear, and laid down the corn with great regularity. The teeth in the gathering cylinder were placed rather high, so that the corn leant a good deal from them, so as to bring the lower end of it round first, and lay it at an angle of about forty-five degrees, whereas it would have been better if it had been laid right across. This could easily have been accomplished by drawing the machine right against the corn. The sharpening apparatus is not given in this machine, because it has already been introduced into the machine described under our article Agriculture.

Mr. Gladstone has likewise constructed a machine for reaping beans, which has been actually used, and which cut down in great perfection, *four* acres in a day, with one man and one horse. The beans were afterwards to be gathered into sheaves and bound up, but we believe Mr. Gladstone afterwards made similar machines, in which the man guided the machine, and either gathered the beans, or made the machine gather them at the same time.

REAUMUR, Rene-Antoine Ferchault, an eminent French naturalist, was born at Rochelle in 1683. He was educated for the bar, but being particularly fond of mathematics, natural history and physics, he went to Paris in 1703, where he distinguished himself so highly, that he was elected a member of the Academy of Sciences in 1708. The Memoirs of this learned body from 1709 to 1763, contain nearly a hundred memoirs on various useful and important subjects written by our author. The improvement of the manufactures of France was a constant object of his attention, and he made many important discoveries respecting the conversion of soft iron into steel, and the softening of cast iron so as to make the cast as fine as in wrought iron. These labours were rewarded by the Duke of Orleans, the regent of the kingdom, who gave him a pension of 12,000 livres, or about £500 sterling; but he refused to accept of it unless it was granted in name of the Academy, and continued to that body after his death. An account of these investigations he published in 1722, in a work entitled, *L'Art de Convertir le fer Forgé en Acier, et L'Art d'Adoucir le Fer Fondu.* Reaumur also introduced into France the manufacture of tinned plates, and he made many experiments on the manufacture of porcelain, which contributed greatly to the advancement of that art in France.

Our author made numerous experiments on the method practised in Egypt of hatching chickens by artificial heat, of which he has given an account in a work published in 1752, in 2 vols. under the title of *L'Art de Faire Eclore, et d'Eléver en Toute Saison des Oiseaux Domestiques.* Of the methods described in this work, we have already given some account in our article Hatching, Vol. X. p. 658, 659.

In natural history, our author is chiefly celebrated for his entomological writings. Besides many papers on that subject, printed among the Memoirs of the Academy of Sciences, he published an elaborate work, entitled *Mémoires pour servir a Histoire Naturelle des Insectes,* in 6 vols. 4to; the first of which was published at Paris in 1734, and the other five between that year and 1742. This work contained many original observations, made with the greatest care, on the physiology of insects of all kinds. Reaumur likewise made many curious experiments on the digestive powers of the stomach in graminivorous and carnivorous animals, and he established the different modes of action in those two classes, viz. that of trituration and solution.

The name of Reaumur has been rendered popular by his method of graduating the thermometer. He always used spirit of wine, and placed the freezing point at 0°, and the boiling point at 80°.

Reaumur was a man of excellent private character, correct in his morals, and agreeable and amiable in his manners. He died at Bermondiere in the Maine from a hurt in his head, received from a fall in 1757, at the age of seventy-five, leaving his MSS. and his cabinet of natural history to the Academy of Sciences.

RECREATIONS Philosophical. See Scientific *Recreations.*

RED Sea, or the Arabian Gulph. See Asia, Vol. II. p. 548; Egypt, Vol. VIII. p. 393. See also Hodeida, Vol. XI. p. 71; Jidda, Vol. XI. p. 753; Loheia, Vol. XIII. p. 149; and Mocha, Vol. XIV. p. 590.

REDRUTH, a market town of England, in the county of Cornwall, is situated in a bleak exposure, on the road from Launcestown to the Land's End. It consists of one long street, occupying the declivity of an eminence in the centre of the mining district. The parish church, about half a mile from the town, and erected in 1770, is a neat building, consisting of a nave, with a flat ceiling, supported by pillars. There are also meeting-houses for the Quakers, Anabaptists, and Methodists. In 1807, a large school-house was built by subscription; but as the subscriptions have been discontinued, it is used by the master on his own account. A Sunday School for 200 boys and girls is taught gratis. This town is supported entirely by the mines in the neighbourhood, the principal of which are the Gwennap Mines, which lie to the south-east of Redruth, in a part of the country where the tin and copper lodes intersect each other.

Redruth is a place of great antiquity, and is a corruption of Dre-Druith, or Druid's Town. About a mile and a half to the west of the town is Carn-breh-hill, which is thought to have been the centre of Druidical worship in the county. On its summit is a circular fortification, called the Old Castle, which seems to have been once surrounded with a strong wall. The population of the parish in 1811 was 5903, and in 1821, 6607. See the *Beauties of England and Wales,* vol. ii.

REFLEXION. See Optics, Vol. XV. p. 426, 533, 623.

REFORMATION. See Ecclesiastical History, Vol. VIII. p. 317.

REFRACTION. See Optics, Vol. XV. p. 499, 522.

REFRACTION, Double. See Optics, Vol. XV. p. 571.

REFRACTIVE Powers, Table of. See Optics, Vol. XV. p. 501.

REFRANGIBILITY of Light. See Optics, Vol. XV. p. 535.

REGGIO, the Rhegion of the Greeks, and the Regium Julii of the Romans, is a considerable town of Naples, and the capital of Calabria Ultra. It is situated upon a hill on the straits of Messina, in a delightful country, abounding in oranges, citrons, mulberries, vines, and palm trees. The town is tolerably well built, many of the houses being composed of the remains of ancient buildings. It has a cathedral, eleven churches, seven convents, and two colleges. The inhabitants manufacture stockings, gloves, and waistcoats of thread or silk. The silk is partly raised in the vicinity, from the silk worm, and a substance like it is procured from the shell-fish called the Pinna marina. Wax, oil, and fruit, are exported from the place. Population about 17,000. East Long. 16° 53′, North Lat. 38°, 6′.

REGIMEN. See Aliments, Vol. I. p. 511.

REID, Thomas, D.D. a celebrated Scotch metaphysician, was born at Strachan, in the county of Kincardine, in April 1710. His father, Lewis Reid, was minister of that parish; and his mother, who was the daughter of Mr. Gregory of Kinnairdie, in Banffshire, was the sister of David, James, and Charles Gregory, who were at the same time professors at Oxford, Edinburgh, and St. Andrews. After receiving the elements of education at the parish school of Kincardine, he was sent to a classical school in Aberdeen, and, at the age of thirteen, he was entered a student of Marischal College.

After studying theology, and taking his degree of master of arts, he was appointed to the office of librarian to the college, and in that situation he formed an intimate acquaintance with Mr. John Stewart, afterwards Professor of Mathematics in Marischal College. In the year 1736, Mr. Reid resigned the office of librarian, and accompanied Mr. Stewart in a tour through England, during which they visited London, Oxford, and Cambridge, and became acquainted with many gentlemen of the first distinction in literature and science. In the metropolis, his connexion with Dr.

David Gregory obtained him easy access to the house of Martin Folkes, the President of the Royal Society, where he met with many eminent individuals. At Cambridge he became acquainted with Dr. Bentley, and he had frequent communications with Saunderson, the blind Mathematician.

Our author had scarcely returned from this interesting tour, when the King's College of Aberdeen presented him, in 1737, to the church of New Machar. His ordination to this charge, however, was attended with very unpleasant circumstances. On account of the hostility which then prevailed against the law of patronage, his admission met with the most violent opposition, and he was even personally exposed to danger. These irritated feelings were soon subdued. His exemplary discharge of the duties of a Christian pastor, his active benevolence, and his forbearing and conciliatory temper, subdued the temporary prejudices of his people, and united him to his parish by those ties which it is painful to see so often severed. This mutual attachment between him and his parishioners was greatly strengthened by his marriage, in 1740, to his cousin Elizabeth, (daughter of Dr. George Reid, physician in London,) whose kindness and active charity to the sick and the poor were long held in affectionate remembrance.

Although Mr. Reid had, during his philosophical and theological studies at the university, begun that train of metaphysical inquiries in which he afterwards acquired such distinguished eminence, yet it was in the peaceful seclusion of a clerical life that he found leisure to devote to these abstract pursuits the whole vigour of his faculties. The recreations of gardening and of botany seemed to relieve his mind from the intensity of its application, and it was by a judicious combination of deep study with superficial amusements, that he was able to pursue, without interruption, those trains of abstract thought which were necessary in studying the laws of external perception, and those principles which constitute the basis of human knowledge.

In the year 1748, Mr. Reid published, in the Philosophical Transactions of that year, his *Essay on Quantity, occasioned by reading a Treatise, in which simple and compound ratios are applied to virtue and merit.* The treatise here referred to was Dr. Hutcheson's *Enquiry into the Origin of our Ideas of Beauty and Virtue.* Dr. Reid's essay met with general admiration, and deserves to be perused by those who are disposed to employ mathematics in inquiries which afford no data for their application.

The reputation which Mr. Reid acquired by this essay, and the high attainments which his friends knew he had made in ethical inquiries, induced the professors of King's College, Aberdeen, to appoint him to the chair of moral philosophy, which had become vacant in 1752. The plan of his course comprehended mathematics, physics, logic and ethics; and for tracing these various branches of knowledge, no man was better qualified than Mr. Reid.

Mr. Hume's *Treatise on Human Nature,* which appeared in 1739, had attracted the particular notice of Mr. Reid. From a superficial view of the subject, he was disposed at first to admit the principles of Mr. Hume's reasoning; but when a more minute inquiry had displayed to him the consequences of these views, he was led to suspect their accuracy, and ultimately to renounce them as unfounded. In this way our author was led to compose *An Inquiry into the Human Mind* on the principles of common sense. The object of this work, which appeared in 1764, was to refute the opinions of Locke and Hartley respecting the connexion which they supposed to exist between the phenomena, powers, and operations of the mind, and to found human knowledge on a system of instinctive principles. The opinion which was entertained of this work was in the highest degree favourable, and even among those who were most inclined to dissent from its canons. His fellow professors favoured him, on the occasion, with the degree of doctor in divinity, and he was invited by the professors of the university of Glasgow to fill the vacant chair of moral philosophy. Mr. Hume, to whom the Inquiry was sent, appears to have entertained, or rather to have expressed, different opinions of its merit. In a letter to the Rev. Dr. Hugh Blair, not written with his usual good taste, he remarks, "I wish that the parsons would confine themselves to their old occupation of worrying one another, and leave philosophers to argue with temper, moderation, and good manners." Whereas, in a letter to Dr. Reid himself, he observes, "By Dr. Blair's means I have been favoured with the perusal of your performance, which I have read with great pleasure and attention. It is certainly very rare that a piece so deeply philosophical is wrote with so much spirit, and affords so much entertainment to the reader; though I must still regret the disadvantages under which I read it, as I never had the whole performance at once before me, and could not be able fully to compare one part with another. To this reason chiefly I ascribe some obscurities which, in spite of your short analysis or abstract, still seem to hang over your system. For I must do you the justice to own, that when I enter into your ideas, no man appears to express himself with greater perspicuity than you do; a talent which, above all others, is requisite in that species of literature which you have cultivated. As I was desirous to be of some use to you, I kept a watchful eye all along over your style; but it is really so correct, and so good English, that I found not any thing worth the remarking. There is only one passage in this chapter where you make use of the phrase *hinder to do,* instead of *hinder from doing,* which is the English one; but I could not find the passage when I sought for it. You may judge how unexceptionable the whole appeared to me, when I could remark so small a blemish."

The invitation which our author received from Glasgow was too flattering to be refused. Though much attached to his colleagues in Aberdeen, yet the prospect of enjoying the society of Black, Simson, Leechman, the two Wilsons, and Millar, and other advantages which a chair in that university presented, induced him to accept of the appointment.

In the year 1773, Dr. Reid published, in the third volume of Lord Kames' *Sketches of the History of Man,* in the form of an appendix, "A Brief Account of Aristotle's Logic, with Remarks by Dr. Reid," which has been deemed, by very competent judges, an admirable and perspicuous analysis of the Aristotelian philosophy. "In attempting," he himself remarks, "to give some account of the analytics and of the topics of Aristotle, ingenuity (ingenuousness) obliges me to confess, that though I have often proposed to read the whole with care, and to understand what is intelligible, yet my courage and patience always failed before I had done. Why should I throw away so much time and painful attention upon a thing of so little use? If I had lived in those ages when a knowledge of Aristotle's Organon titled a man to the highest rank in philosophy, am- tion might have induced me to employ upon it some ears of painful study, and less I conceive would not e sufficient. Such reflexions as these always got the bet- r of my resolution when the ardour first began to cool. ll I can say is, that I have read some part of the dif- rent books with care, some slightly, and some per- aps not at all. I have glanced over the whole often; nd when any thing attracted my attention, I have dip- ed into it till my appetite was satisfied."

The approach of age and of its attendant infirmities, nduced Dr. Reid to withdraw from the duties of a ublic lecturer in the year 1781, when he had passed is seventieth year. He was the more inclined to take his step, as he had only a few years to count upon for ompleting his great work on the Human Mind, in which he had made considerable progress. He accord- ngly devoted all his time to this task, and, in 1785, e was enabled to publish his *Essays on the Intellectual Powers of Man*, which were followed in 1788, with his *Essays on the Active Powers of Man.*

Having thus been permitted to complete his great work, our author now devoted a greater portion of his ime to general science. He took a deep interest in he discoveries of modern chemistry, to which the la- ours of his friend and colleague Dr. Black had so es- entially contributed; and he even diligently studied the new nomenclature of Lavoisier, and the new the- ries on which it was founded. Several short essays, n subjects which had interested him, he read from ime to time to a philosophical society at Glasgow, of which he was a member; and the last of these, which was written in his 86th year, was communicated to the society only a short time before his death.

In the summer of 1796, he spent some weeks with his friends in Edinburgh; but about the end of September, soon after his return to Glasgow, he experienced a sharp attack of a violent disease, which, aggravated by repeated strokes of palsy, put an end to his long and venerable life on the 7th October, in the 87th year of his age.

Along with a sound and vigorous mind, nature had conferred on Dr. Reid a strong and healthy constitution, and a powerful and muscular frame. Temperance and regular exercise protected him against the disorders incident to a sedentary life, and the serenity of his temper conspired with these bodily qualities to prolong his life beyond its ordinary limits.

In his moral character, Dr. Reid was inflexibly upright, deeply attached to truth, and possessed of a thorough mastery over his passions. In his disposition he was peculiarly gentle and modest; and he had acquired that true humility which profound knowledge and Christian hope never fail to impress upon our nature.

As a lecturer, Dr. Reid was in no respect distinguished by any attractions either of elocution or of manner. The simplicity and perspicuity of his style corresponded with the dignity and gravity of his demeanour; and in his latter days, the proper respect with which his lectures were always listened to, rose to that high veneration which is ever paid to old age, when clothed with the attributes of wisdom and of virtue.

The philosophy of Dr. Reid, though it still flourishes in Scotland, has never yet made its way into the sister kingdom; and the two countries are as much divided in their metaphysical faith, as they formerly were in questions of national policy. The peculiar doctrines of Dr. Reid have, with some exceptions, been maintained by his friend and biographer Mr. Dugald Stewart, who has illustrated them with his usual ingenuity and eloquence.

For farther information respecting the life and writings of Dr. Reid, we must refer our readers to Mr. Stewart's interesting account of his life and writings.

In our articles LOGIC, Vol. XIII, METAPHYSICS, Vol. XIV, and MORAL PHILOSOPHY, Vol. XIV, our readers will find much information respecting the philosophy of Dr. Reid.

REIKIAVIK. See ICELAND, Vol. XI. p. 647, &c. &c. and the works quoted under that article.

RELIGION. See CHRISTIANITY, METAPHYSICS, MORAL PHILOSOPHY, and THEOLOGY.

REMBRANDT, VAN RYN, a celebrated Dutch painter, was born at a village near Leyden, in the year 1605. His real name was Gerretss; but he took the name of Ryn from a village on the Rhine, in which he resided in early life.

Rembrandt received his first instructions in painting from Zwanenburg, and afterwards studied under Peter Lastman and Jacob Pinas, from the last of whom he is thought to have derived his passion for powerful contrasts of lights and shadows.

The talents of Rembrandt were first noticed by a connoisseur at the Hague, to whom he had brought a picture for sale. Convinced of the merit of the picture, he gave him a hundred florins for it, and treated him with much kindness. This incident immediately extended his reputation, and he soon found himself in the possession of full employment. The pupils whom he received into his school, paid him a hundred florins a year; and he often sold as originals, their copies of his pictures, after having given them a few touches of his own pencil. In this way, and by the sale of his etchings, which he executed with great facility, he accumulated considerable wealth; and he is said, after his removal to Amsterdam, to have been in the receipt of at least 2500 florins annually.

The execution of his picture of the Woman Taken in Adultery, in the collection made by Mr. Angerstein, is characterized by great minuteness and patience of touch; but he afterwards used his pencil with more freedom, and even used the stick, the pallet, the knife, or his finger, to produce effects, which though unable to bear a near examination, were every way admirable at the proper distance.

Rembrandt was distinguished by many singularities, and latterly by a great degree of avarice, which he displayed in ways by no means creditable.

When he was one day painting a whole family in a single picture, he received notice of the death of his monkey; affected by the loss of that animal, he forgot his customers, and painted the monkey along with them on the same canvass. He is said to have tried various schemes for obtaining a high price for his etchings. Sometimes he made his son sell them, as if he had stolen them from his father. At other times he exposed them to sale, and went in disguise to bid for them. Sometimes he threw off and sold unfinished proofs, and when they were afterwards finished, they appeared as fresh plates; and sometimes he created a temporary demand for them, by announcing his intention of leaving Holland. His scholars, to whom his love of money was well known, once painted some pieces of money upon cards, which tempted Rembrandt to take them up.

Among his scholars, Bohl and Eckhoud seem to pulation of which is about 80,000. West Long. 1° 36′, North Lat. 48° 7′.

RENNET. See Dairy, Vol. VII. p. 550.

RENNIE, John, a celebrated civil engineer, was the youngest son of a respectable farmer at Phantassie, in the parish of Prestonkirk, and county of East Lothian, and was born there on the 7th June, 1761. He had the misfortune to lose his father at the early age of five, but his education was carried on at the parish school by his surviving relatives. The peculiar talents of young Rennie seem to have been called forth and fostered by his proximity to the workshop of the celebrated mechanic, Andrew Meikle, the inventor or improver of the thrashing machine, and in his frequent visits to that scene of mechanism, he was constantly occupied in using, and perhaps as often in abusing the tools that fell in his way. As he advanced in years, however, he began to imitate at home the models of machinery which he had seen, and at the early age of ten he had made the model of a windmill, a steam engine, and a pile engine, the last of which is said to exhibit much practical dexterity.

In the year 1773, Rennie left the school at Prestonkirk, in consequence of some misunderstanding with the schoolmaster, whom he had conceived to be incapable of advancing him in his studies; and he entered into the employment of Andrew Meikle, with whom he continued till 1775. Finding, however, that he was still far behind in his education, he went to Dunbar to study mathematics under Mr. Gibson, and in 1777 he returned to work with Mr. Meikle, with considerable addition to his former stock of knowledge.

Mr. Gibson having, about this time, been elected Master of the Academy of Perth, recommended Rennie as his successor at Dunbar; but though he taught the school for some weeks, to oblige his friend, he never thought of continuing it as a profession; and he accordingly renewed his mechanical labours under Mr. Meikle, employing his leisure hours in modelling and drawing machinery. Before he had reached the age of eighteen, he had erected two or three corn mills in his native parish; but the first undertaking which he executed on his own account was the rebuilding of the flour mills at Invergowrie near Dundee.

By zealously prosecuting his professional labours in summer, he was enabled to visit Edinburgh in the winter season, when he attended the lectures of Dr. Robison on Natural Philosophy, and those of Dr. Black on Chemistry, and thus to fit himself for the profession of a civil engineer, to which he seems now to have aspired. Dr. Robison recommended him to Messrs. Bolton and Watt at Soho, and on his way to that place, he examined the aqueduct bridge at Lancaster, the docks at Liverpool, and the interesting works on the Bridgewater canal. After remaining some months at Soho, Mr. Rennie made a tour through the manufacturing districts of Yorkshire, and then settled in London.

The erection of the Albion Mills in London about this time may be considered as an epoch in the history of the great practical establishments of Britain. Messrs. Bolton and Watt, and Mr. Wyatt, who planned this scheme, and were the principal proprietors of it, had the millwork and machinery executed and put up under the direction of Mr. Rennie; and Mr. Watt has himself recorded the valuable assistance which had been derived from his friend in this great work.* The fine establishment of the Albion Mills, completed in 1786 or 1787-9, and which was an honour to our country, was abused by the learned as well as by the ignorant mob of the day, as a monopoly injurious to the public good, whereas, it cannot be doubted that they greatly reduced the price of flour while they continued at work. The destruction of these mills in 1791 by fire, which was certainly the result of design; and the loss of all the machinery which they contained, will be ranked among those disgraceful outrages against individual property which have cast a stain upon our national character. "The Albion Mills," says Mr. Watt, *(loc. cit.)* "consisted of two engines, each of fifty horses power, and twenty pairs of millstones, of which, twelve or more pairs, with the requisite machinery for dressing the flour and for other purposes, were generally kept at work. In place of wooden wheels, always subject to frequent derangement, wheels of cast-iron, with the teeth truly formed and finished, and properly proportioned to the work, were here employed, and other machinery which used to be made of wood, was made of cast-iron in improved forms; and I believe the work executed here may be said to form the commencement of that system of millwork which has proved so useful to this country.

In the construction of that millwork and machinery, Bolton and Watt derived most valuable assistance from that able mechanician and engineer Mr. John Rennie, then just entering into business, who assisted in planning them, and under whose direction they were executed. The engines and millwork were contained in a commodious and elegant building, designed and executed under the direction of the late Mr. Samuel Wyatt."†

The mechanism of the Albion Mills introduced Mr. Rennie most favourably to the notice of the public; and he soon obtained very extensive employment in constructing numerous sugar mills for the West India planters. Mr. Rennie was also employed to construct the machinery of the powder mill at Tunbridge, the flax mill of Wandsworth, the rolling and triturating mills of the Mint in London, and the machinery of various breweries and distilleries.

In all the millwork erected by Mr. Rennie, there was one striking improvement which he mentioned to the writer of this notice, as introduced by himself. It was formerly usual to place the vertical axis of the running millstone in a bush, placed in the middle of the horizontal bridgetree, which was supported only at its two extremities. The effect of this was that the bridgetree yielded to the variations of pressure arising from the greater or less quantity of grain which was admitted between the millstones, which was conceived to be an useful effect. Mr. Rennie, however, made the bridgetree perfectly immoveable, and thus freed the machinery from that irregular play which sooner or later proves fatal to every kind of mechanism.

Mr. Rennie was no less celebrated in the architectural than he was in the mechanical branch of his profession. We are not correctly acquainted with the precise share which Mr. Rennie had in the design of the aqueduct bridge over the Lune at Lancaster, which has been ascribed to him; but the stone bridges of Kelso,

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* Robison's *Elements of Mechanical Philosophy*, vol. ii. p. 137. *Note.*

† Mr. Watt, in the work just quoted, has engraven one of the Albion Mill engines, which was a double one, with the grinding machinery which it put in motion.

Leeds, Musselburgh, Newton Stewart, Boston, and New Galloway, testify sufficiently his judgment and taste in the art of bridge building. The first of these bridges, which was completed between 1799 and 1803, is thrown over the Tweed, immediately below its junction with the Tiviot, and consists of a level roadway resting on five elliptical arches, each of which has a span of seventy-three feet, and a rise of twenty-one feet. Its character is peculiarly suited to the fine scenery which surrounds it, and it is perhaps one of the most beautiful specimens of the art which is to be seen. The writer of this article, when he first had the pleasure of being introduced to Mr. Rennie, stated to him this high opinion of the superiority of Kelso bridge, without being aware that it had been designed by himself. Mr. Rennie was highly gratified by this honest testimony to his talents, and the more so, as he considered the design of Kelso bridge as one of the very best which he ever made.

We may here mention an anecdote respecting the bridge of Musselburgh, with which Mr. Rennie himself was much entertained. When he was taking that work off the hands of the contractor, one of the magistrates who was present took an opportunity of asking a countryman who was passing at the time with his cart, how he liked the new bridge. "Brig," replied the man, "it's nae brig ava; ye neither ken whan ye gang on't or whan ye come aff't." The old bridge has a very precipitous roadway, and being in this and in other respects the very counterpart of the new one, the homely opinion given above may be considered as one of the highest compliments that could have been paid to the engineer.

Mr. Rennie's celebrity as a bridge builder, however, must always be attached to the Waterloo bridge over the Thames, one of the grandest monuments of architectural skill, and of British enterprise. This stupendous work, completed in 1817, has not altered more than five inches from a straight line on any one part of it.[*] One of the best designs of Mr. Rennie was that of a stone bridge over the Thames, on the site of the present London bridge. It was selected by the Committee as the best of at least thirty plans, and is to be executed in Aberdeen granite, of five arches, the middle one of which is to have a span of 150 feet.

The principal iron bridges designed and constructed by Mr. Rennie, are a small one over the Witham at Boston, which has been engraven in our article BRIDGE, Vol. IV. p. 489, Plate XCIV.; and the great one at Southwark,[†] which, notwithstanding the various prophecies against its stability, has stood unaffected either by the summer's heat or the winter's cold. Mr. Rennie likewise designed another of three arches, of ninety, eighty, and seventy feet span, for the river Goomty at Lucknow, but the Nabob of Oude would not allow it to be erected, after it was sent out by the East India Company.

In those public works, which come more immediately under the profession of a civil engineer, Mr. Rennie had still more experience, and has been equally successful.

Among the canals, the execution of which he personally superintended, have been enumerated the Lancaster canal, that at Aberdeen, the Grand Western, the Kennet and Avon, the Portsmouth, the Birmingham, and the Worcester,[‡] &c. &c.

Besides the West India docks already described in our account of the Metropolis, (see the article LONDON, Vol. XIII. p. 168,) Mr. Rennie is said to have planned the docks at Hull, Greenock, Leith, Liverpool, and Dublin; together with the harbours of Berwick, Dunleary, Holyhead, Howth, Newhaven, Queensferry, &c. In addition to these naval works, he planned various important improvements on his Majesty's dockyards at Portsmouth, Plymouth, Chatham, and Sheerness, and the new naval arsenal at Pembroke was constructed from his designs. He made a design also of a new naval arsenal at North-fleet on the Thames, but the sum of eight millions was considered by government as too great a sum to be expended on the undertaking.

The greatest of all Mr. Rennie's naval works, however, is undoubtedly the Breakwater at Plymouth, of which we have already given a very full description.[§]

In concluding this list of Mr. Rennie's labours, which has necessarily become a meagre one, in consequence of our having given accounts of them in other parts of our work, we must not omit his drainage of that tract of marsh lands on the river Trent, Witham, New Welland, &c. and his plan for draining the Bedford level, which has been partly carried into execution.

These various public concerns are said, by one of Mr. Rennie's biographers, to have cost little less than fifty millions sterling, nearly twenty millions of which were spent under his own superintendence.

Although Mr. Rennie was a man of robust figure, and of corresponding strength of constitution, yet, during some of the last years of his life he had been afflicted with an inflammation of the liver. The disease, however, began to assume a more serious form, and finally cut him off, on the 16th of October, 1821, in the 60th year of his age. His remains were interred in St. Pauls, near those of Sir Christopher Wren, and a plain granite slab, with a suitable inscription, was laid upon his tomb.

Mr. Rennie, who married in 1789, and survived his wife, left behind him six children. The eldest of these, Mr. George Rennie, has already exhibited very great talents in his father's profession, and the second son, John, promises to sustain the reputation of the family.

Mr. Rennie may be justly considered as the first of that school of *practical* Engineers which has been established in Great Britain. No mistake can be greater than to suppose, (as has been generally stated,) that Mr. Rennie was a profound mathematician, or a natural philosopher. Had he been either, he would never have executed those great works which have given renown to his own name, and to that of his country. When we consider the vast superiority of the French engineers to our own, in *theoretical acquirements*, and their inferiority to ours in practical knowledge of every kind, we cannot avoid drawing the conclusion, that it is from experience alone that those resources of skill and judgment are to be derived which have given pre-eminence to all the works of British engineers. The experience of foreign countries has shown, that a mere

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[*] An account of this bridge has been given in our article LONDON, Vol. XIII. page 153.

[†] See our article LONDON, Vol. XIII. p. 158, col. 2.

[‡] Mr. Rennie's biographer, whom we have followed in this enumeration, has added the *Brechin canal*, but no such canal exists.

[§] See our article PLYMOUTH BREAKWATER, Vol. XVI. p. 663.

Rennie.

knowledge of pure mathematics is more easily acquired than that of any branch of science, or of useful knowledge; and consequently, the possession of it indicates no talent, and no genius of any kind. Those, therefore, who have been early initiated into its abstractions, experience great difficulty in abandoning the results of theory, and in throwing themselves entirely upon the resources of experiment and observation; while those who have founded their professional acquirements upon the great practical truths, which are often collected from the experience of ages, have frequently rejected the aid of theory, even in those cases where its assistance might have been advantageously accepted. Like all extremes, these two are to be carefully avoided; but that extreme is to be especially guarded against, which would lead us to renounce those opinions of the value of practical science, which, without naming any living examples, are founded on the history of the lives and labcurs of Bolton, and Watt, and Rennie.

Although Mr. Rennie did not devote himself to the acquisition of theoretical knowledge, excepting to that general extent which is required by every well-informed engineer, yet he was fond of those investigations of a mixed character, where the results of experiment were combined by mathematical rules, and a train of inquiry directed and modified by the lights of theory. The writer of this article cannot forget the pleasure which he one day afforded to Mr. Rennie, by giving him a minute account of the beautiful results obtained by Coulomb, respecting the resistance of fluids by his fine application of the principles of Torsion.

Rennie has been compared with Smeaton as an engineer; but the parallel is, in our opinion, not a correct one. Smeaton possessed much more theoretical knowledge than Rennie, and Rennie surpassed Smeaton in his practical resources. The latter was more of a man of science; and, if he was less of a practical engineer, we may ascribe it, in some degree, to his having flourished at an earlier period of the arts, and at a time when the military and naval resources of our country were not called forth for its defence, and when British capital, and British enterprise, had not dared to embark themselves in works of national magnitude and interest.

If we could venture, at such an early period after Mr. Rennie's death, when the adage of *De mortuis nil nisi bonum* is in full force, to give an opinion upon his works, we should be disposed to say, that they are sometimes characterized by a massiveness, and, consequently, by an expence which *may not* have been absolutely necessary under all the circumstances of their erection. The perfection of civil engineering must always be held to consist in the production of a work with the least expence of labour and materials. In looking forward to the ravages of time and of accident, there is of course no point at which we can set limits to our caution. The engineer may, with more propriety, strengthen his bridge or his aqueduct against some future assault of hostile cannon, than defend them against floods that never flowed, against pressures that never pressed, or against winds that never blew. In contemplating the firmness of fresh granite, or the toughness of newly-forged iron, we are apt to forget that time corrodes and disintegrates both; and that diseases to which even their obdurate nature is subject, sometimes unite their strength to that of the great destroyer. If these observations have any force in regard to works whose expence is defrayed out of the public treasury, their application must be still more pointed to those of a commercial character, which have been undertaken by individuals as an investment of their capital. Here the economy of construction ought to be the principal object of the engineer, and a regard for his own reputation, and even many public considerations, ought to be kept in due subordination to that leading object.

Had it been our fortune to be a well-employed engineer, we would have cheerfully witnessed the failure of some favourite erections, provided we could, at some distant period, be indulged with the sight of the remainder balanced in skilful equilibrium, and exhibiting their airy stability to the wonder and admiration of succeeding ages.

The caution of those engineers (among whom Mr. Rennie cannot be placed) who habitually shelter their scientific character under a mass of stone and iron, may be compared to the prudery of some men of science, who are exceedingly timorous of error, and who spend their lives in polishing and working up some slender, or perhaps considerable discovery. The bold and skilful engineer, on the contrary, resembles those adventurous spirits who pant only after triumphs, and forget the slips they may have committed in securing them. The failures of the one, and the errors of the other genius, are no doubt emblazoned for a while by contemporary or local malignity; but time refuses to collect the chaff which the breath of envy has raised, and posterity takes cognizance only of those labours of genius which never die.

We have been led into these remarks solely with the view of explaining the grounds of the criticism which, with much hesitation, we have made on the character of some of Mr. Rennie's undertakings; but this criticism, even if it is a correct one, cannot be supposed to affect our opinion of his pre-eminent merits as a civil engineer.

We are not aware that Mr. Rennie is the author of any Memoir in the transactions of our learned societies.

An excellent bust of Mr. Rennie was executed in his life-time, by our great artist Chantry, and a good medallion by Bain has been copied from it. The late Sir Henry Raeburn also painted two excellent portraits of him. Mr. Rennie had a fine commanding figure, and was of a robust make, and greatly above the middle size. His features were strong and large, and his expression mild and agreeable.

Various biographical sketches of Mr. Rennie have appeared in our periodical works, and an eulogy upon him was written soon after his death by M. Charles Dupin.

RENT. See Political Economy, in this volume, p. 50.

REPEATING Circle. See Circle, Vol VI. p. 498. 514.

REPEATING Clocks and Watches. See Horology, Vol. XI. p. 145—151.

REPTILES. See Herpetology, Vol. XI. p. 1; and Ophiology, Vol. XV. p. 452.

REPUBLIC. See Government, Vol. X. p. 341.

RESERVOIR. See Navigation, *Inland*, Vol. XV. p. 309.

RESINS. See Gums, Vol. X. p. 556; and Chemistry, Vol. VI. p. 108, 121—128.

RESISTANCE of Fluids. See Hydrodynamics, Vol. XI. chap. v. p. 542—551; and Pneumatics, Vol. XVI. p. 681—691.

RESPIRATION. See PHYSIOLOGY, Vol. XVI. chap. viii. p. 554—567.

RETFORD, or REDFORD, EAST, a borough and market town of England, in the county of Nottingham. It is agreeably situated on the eastern bank of the river Idle, the village of West Retford being situated on the opposite bank, and connected with East Retford by a handsome modern bridge. The town consists of an open square, surrounded with good and regularly built houses. The parish church, called the Corporation Church, dedicated to St. Swithin, is a small but neat edifice, in the English style of architecture, with a handsome square tower, though greatly ornamented in the interior with recent improvements. The town-hall, occupying a great portion of the market place, is a neat and commodious building, the shambles being placed beneath the principal room. The other buildings and establishments are Sloswick Hospital, built by the corporation in 1806; a free school, endowed by Edward VI.; and an almshouse for twelve poor women. The chief manufactures are those of sailcloth, hats, candle-wicks, and paper. The town derives much advantage from the Chesterfield canal from the Trent.

East Retford sends a member to parliament, who is chosen by 112 voters. The town is managed by two bailies, twelve aldermen, and two chamberlains, a town-clerk, and two serjeants.

The village of West Retford has a neat church, with a spire on a square tower, and some ancient monuments. The village is thriving, and has an hospital for sixteen poor persons, founded by Dr. Donel in 1666. See Throsby's edition of Thornton's *History of Nottinghamshire*, vol. iii.; and *Beauties of England and Wales*, vol. xii. p. 293.

RETINA. See ANATOMY and OPTICS.

RETZ, CARDINAL, born in 1614, and died in 1679. See FRANCE, Vol. IX. p. 599.

REVEL, or KOLYVAN, a sea-port town of Russia, and the capital of Esthonia, is situated on the Baltic, on a small bay in the Gulf of Finland. The town is divided into three parts. The streets are in some places regular, and in others the reverse, and very narrow, and he houses are generally built of brick. Revel contains hirteen churches, six of which belong to the Russian Church, and the rest to the Lutherans. The other buildings and establishments are a military academy, n arsenal, a public library, with schools, hospitals, nd almshouses. The town is surrounded with high walls, which are strengthened by bastions and a deep itch. It is also fortified by a castle, placed upon a ock, and adorned with several towers.

The harbour, which is large and spacious, usually accommodates a part of the Russian fleet. It is secure gainst all winds, and protected by some fortified lands at its mouth. From 100 to 120 vessels enter it very year. The principal exports from Revel are timer, corn, and hemp; and it imports sugar, coffee, bay lt, and articles of British manufacture. The followg were the value of the exports and imports, from 780 to 1795:—

	Imports.		Exports.
1780,	473,241 rubles.	-	151,416 rubles.
1788,	259,292	- -	112,956
1792,	2,934,919	- -	108,327
1795,	1,765,294	- -	417,349

This great increase in the imports arises from some fficulties at Riga. The rise in value of the exports in te years is from 5 to 600,000 rubles; and of the imports, from 150 to 200,000. The articles of commerce at Revel are the same as those which we have mentioned under Riga. It has small manufactories for glass, woollen stockings, pins, hair-powder, leather, and soap. There is also here a foundry for cannon.

As Revel was founded by the Danes in 1218, and received several of its privileges from Danish sovereigns, the arms of Denmark, with inscriptions in Danish, still exist on the churches and some of the public offices. Population about 13,000. East Long. 26° 39′ 9″, North Lat. 59° 26′ 33″.

REVELATION. See CHRISTIANITY.

REYGATE. See RYEGATE.

REYNOLDS, SIR JOSHUA, a celebrated British painter, was born on the 16th of July, 1723, at Plympton, in Devonshire. His father was master of the grammar school of Plympton, and though a person of singular character, he perceived his son's early passion for drawing, which he encouraged with all the liberality in his power. When quite a child, our young artist copied sketches made by his elder sister, and likewise the prints from Cot's Book of Emblems. At the early age of eight he studied, and even comprehended, the "Jesuits Perspective," and having a short time afterwards obtained a copy of Richardson's "Treatise on Painting," he was so fascinated with the perusal of it, and cherished such an enthusiastic feeling for Raphael, that he resolved to become a painter, and if possible to partake in the glory of the Italian master. In 1740, his father seeing the propensities of his son, placed him under the care of Mr. Thomas Hudson, one of the best portrait painters of his day, and the son-in-law of Richardson, the author of the work above mentioned, from whom he received the usual instruction in his profession. The pupil, however, soon outstripped his master, and in consequence of some differences with him, they parted in 1743. From London he went to Devonshire, where he spent three years of inactivity; but he seems to have been roused from his indolence, and to have returned to London in 1746, where he painted a portrait of Captain Hamilton, father of the late, and great-grandfather of the present Marquis of Abercorn; and perceiving that a true knowledge of art could only be acquired from a careful study of the best masters, he became desirous of visiting Italy. An opportunity of doing this soon occurred, through the friendship of Captain, afterwards Lord Keppel, who took him along with him to visit the shores of the Mediterranean, and to spend some time at Rome. It may easily be conceived how our young artist, influenced by his early prepossessions, was transported at the sight of the works of Raphael which adorned the Vatican. The account which he wrote of his feelings on this occasion, has been published by his biographer, Mr. Malone.

On his return from Italy in 1752, he speedily rose to the head of his profession. His literary acquirements, and the suavity of his manners, recommended him to all the distinguished literati of that period, and he lived on the most intimate footing with Johnson, Goldsmith, Burke, M'Pherson, and many others.

The first portrait which brought him into notice after his return from Italy, was a full length portrait of Commodore Keppel, which was followed by a portrait of Lord Edgecombe and some others, which were highly esteemed. His pencil was soon employed in portraits of some of the greatest beauties of the metropolis, and he speedily became the most fashionable artist of the day. Crowds flocked to see his works, and he was not

Reynolds, Sir Joshua.

able to execute the numerous orders which he received. His historical pictures were in particular request, and it is fortunate for the art that he had leisure to execute so many of this description.

The *Literary Club*, established in 1764, and comprehending the leading men of genius of that time, was organised principally by Reynolds. His literary habits were thus strengthened by his constant association with professional authors, and from his connexion with Dr. Johnson, he was led to compose three essays to the Idler, viz. No. 76, on False Criticisms in Painting; No. 79, on the Grand Style of Painting; and No. 82, on the True Idea of Beauty.

The Royal Academy of Painting, Sculpture, and Architecture, having been established in 1768, Mr. Reynolds was appointed its first president, and, to add to the dignity of the institution, as well as to mark the royal opinion of Mr. Reynolds's merits, the king conferred upon him the honour of knighthood. At the opening of the academy, on the 2d of January 1769, Sir Joshua delivered his first discourse, which was universally admired, and at the distribution of the prizes which took place in each succeeding year, he delivered to the students a discourse on some branch of the art.

During the summer of 1781, Sir Joshua made a tour through Holland and the Netherlands, in order to examine the celebrated works of the Dutch and Flemish artists. Here he studied with a critical eye the paintings in the churches and collections in Amsterdam, Antwerp, Brussels, Ghent, and Dusseldorf, and he has preserved his opinions of these pictures in an account of his journey, which was published after his death, and which terminates with a masterly drawn character of Rubens.

In 1783, when the Emperor Joseph exposed to sale the pictures belonging to several of the monasteries and religious houses in Flanders, Sir Joshua again visited that country, and he expended above £1000 on the purchase of some of the most interesting. He is said to have observed upon his return, that his own pictures, when compared with those he had purchased, wanted force and brilliancy.

On the death of Allan Ramsay, in 1784, Sir Joshua was made principal painter in ordinary to his majesty, a situation which he held till the time of his death.

Hitherto our author had enjoyed equal health, with the exception of a slight paralytic stroke which he experienced in 1782, and which left behind it no disagreeable effects. In July 1789, however, when Lady Beauchamp was sitting for her portrait, he was unable to proceed with the picture from his loss of sight, and, notwithstanding the exertions of his medical attendants, he became in a few months blind in his left eye. Having been so deaf as to be obliged to use an ear-trumpet ever since his return from Italy, he began to be alarmed lest he should be afflicted with the two greatest calamities to which the human frame is subject, the loss of hearing and the loss of sight. He therefore resolved to save his remaining eye by giving up his labours as an artist, and though he was thus made dependent on a new set of habits, he retained his spirits and partook of the conversation of his friends with his usual cheerfulness. This state of enjoyment, however, did not long continue. Some discussion which about this time took place in the academy disturbed his tranquillity and added to the infirmities of his decaying frame. In 1790, when the professorship of perspective had become vacant, Sir Joshua was extremely desirous of having it filled by Joseph Bonomi, a celebrated Italian architect. Bonomi, however, was only an associate of the academy, so that it became necessary to elect him an academician. Mr. Gilpin was the other candidate on this occasion. When the ballot took place the votes were equally divided, and Sir Joshua gave his casting vote in favour of his friend. On a subsequent occasion when an academic seat was vacant, Sir Joshua exerted all his influence to procure it for Bonomi; but when he found that he was outvoted by two to one, he left the chair with great dissatisfaction and resigned next day. He was afterwards, however, prevailed upon to resume his dignity.

An inflamed tumour that had grown above the eye which he had lost made him unreasonably apprehensive of the loss of the other; and from that time his spirits failed, and a settled despondency took possession of his mind. This effect, however, was partly owing to another disease, which was secretly undermining his frame, and the nature and the seat of which he was unable to point out. This illness was therefore attributed to a wrong cause, and his physicians, with that want of generosity which, in such cases only characterizes their profession, were more willing to brand their patient with the name of hypochondriac than own their ignorance of a disease which was seated beyond their penetration. About a fortnight previous to his death it was discovered that his liver had enlarged itself beyond its ordinary size, and had impeded the exercise of all his vital functions. After being confined to his room for three months, he died at his house in Leicester Square, on the 23d of February, 1792, at the advanced age of sixty-nine. His funeral was attended by a number of very distinguished individuals, and his pall was supported by three dukes, two marquises, and other five noblemen. His remains were deposited in the crypt of St. Paul's, near those of Sir Christopher Wren.

Sir Joshua Reynolds was rather below the middle size, of a ruddy complexion, and somewhat inclined to corpulency. He has left behind him excellent pictures of himself at different periods of his life.

The unclaimed and unfinished works of Sir Joshua, along with his vast collection of pictures, drawings, engravings, casts, and statues, were sold by auction, and brought nearly L.17,000. His whole property amounted to L.80,000. The following character of this great artist is from the masterly hand of Mr. Burke:

"His illness was long, but borne with a mild and cheerful fortitude, without the least mixture of any thing irritable or querulous, agreeably to the placid and even tenor of his whole life.

He had, from the beginning of his malady, a distinct view of his dissolution; which he contemplated with that entire composure which nothing but the innocence, integrity, and usefulness of his life, and an unaffected submission to the will of providence, could bestow. In this situation he had every consolation from family tenderness which his tenderness to his family merited.

Sir Joshua Reynolds was, on very many accounts, one of the most memorable men of his time. He was the first Englishman who added the praise of the elegant arts to the other glories of his country. In taste, in grace, in facility, in happy invention, and in the richness and harmony of colouring, he was equal to the great masters of the renowned ages. In portrait he went beyond them; for he communicated to that description of the art in which English artists are the most engaged, a variety, a fancy, and a dignity, derived from the higher branches, which even those who professed them in a superior manner did not always preserve when they delineated individual nature. His portraits remind the spectator of the invention of history and the amenity of landscape. In painting portraits he appears not to be raised upon that platform, but to descend to it from a higher sphere. His paintings illustrate his lessons, and his lessons seem to be derived from his paintings.

He possessed the theory as perfectly as the practice of his art. To be such a painter he was a profound and penetrating philosopher.

In full happpiness of foreign and domestic fame; admired by the expert in art, and by the learned in science, courted by the great, caressed by sovereign powers, and celebrated by distinguished poets, his native humility, modesty, and candour, never forsook him, even on surprise or provocation; nor was the least degree of arrogance or assumption visible to the most scrutinizing eye in any part of his conduct or discourse.

His talents of every kind, powerful from nature, and not meanly cultivated in letters; his social virtues, in all the relations and all the habitudes of life, rendered him the centre of a very great and unparalleled variety of agreeable societies, which were dissipated by his death.

He had too much merit not to excite some jealousy, too much innocence to provoke any enmity. The loss of no man of his time can be felt with more sincere, general, and unmixed sorrow."

The following character of Sir Joshua as an artist has been drawn by Fuseli in the Supplement to Pilkington's Dictionary:

"In many respects, both as a man and as a painter, Sir Joshua Reynolds cannot be too much praised, studied, and imitated, by every one who wishes to attain the like eminence. All nature, and all art, was his academy, and his mind was constantly awake, ever on the wing—comprehensive, vigorous, discriminative, and retentive. With taste to perceive all the varieties of the picturesque, judgment to select, and skill to combine, what would serve his purpose! Few have ever been empowered by nature to do more from the funds of his own genius; and have ever endeavoured more to take advantage of the labours of others in making a splendid and useful collection, for which no expense was spared. His house was filled to the remotest corners, with casts from the antique, pictures, statues, drawings, and prints, and by the various masters of all the different schools and nations. Beautiful and seducing as his style undoubtedly was, it cannot be recommended in so unreserved a manner as his industry both in study and in practice. Colouring was evidently his first excellence, to which all others were more or less sacrificed; and though in splendour and brilliancy he was exceeded by Rubens and Paul Veronese, in force and depth by Titian and Rembrandt, and in freshness and truth by Velasquez and Vandyke, yet, perhaps, he possessed a more exquisite combination of all these qualities, and that peculiarly his own, than is to be found in the works of any of those celebrated masters. His discourses are written in an easy, agreeable manner, and contain many just observations, much excellent criticism and valuable advice; but, being undertaken before he had profoundly considered the subject, they are frequently vague and unintelligible, and sometimes contradictory."

It has been impertinently stated, that Sir Joshua did not write his own discourses, and that they were composed, or greatly modified, by Mr. Burke. The evidence of Mr. Northcote, who lived with Sir Joshua when he composed them, and who saw the manuscript fresh from the hand of its author, and after it had been submitted to Dr. Johnson and Mr. Burke, completely contradicts this unfounded supposition.

Reynolds, Rheims.

The following is a list of the principal historical pictures executed by Sir Joshua Reynolds:—Hope nursing Love; Venus chastising Cupid for having learned to cast accounts; Count Ugolino in the Dungeon, which is one of his best works; the Calling of Samuel; Ariadne; a Captain of Banditti; Beggar Boy; a Lady in the character of St. Agnes; Thais; Dionysius the Areopagite; an Infant Jupiter; Master Crewe in the character of Henry VIII.; the Death of Dido; a Child asleep; Cupid sleeping; Covent Garden Cupid; Cupid in the Clouds; Cupids painting; Boy laughing; Master Herbert in the character of Bacchus; Hebe; Miss Meyer in the character of Hebe; Madonna, a head; the Black-guard Mercury; a Little Boy (Samuel) praying; an Old Man reading; Love loosing the Zone of Beauty; the Children in the Wood; Cleopatra dissolving the Pearl; Garrick in the character of Kitely; Garrick between Tragedy and Comedy; Mrs. Abingdon in the character of Comedy; a Child surrounded by Guardian Angels; Miss Beauclerc in the character of Spencer's Una; Resignation; the Duchess of Manchester in the character of Diana; Lady Blake in the character of Juno; Mrs. Sheridan in the character of St. Cecilia; Edwin, from Beattie's Minstrel; the Nativity; Four Cardinal Virtues, and Faith, Hope, and Charity, for the window of New College Chapel, Oxford; the Studious Boy; a Bacchante; a Daughter of Lord W. Gordon as an Angel; the Holy Family; the Cottagers, from Thomson; the Vestal; the Careful Shepherdess; a Gipsy telling Fortunes; the Infant Hercules strangling the Serpent; the Mouse-trap Girl; Venus; Cornelia and her Children; the Bird; Melancholy; Mrs. Siddons in Tragedy; Head of Lear; Mrs. Talmash in the character of Miranda, with Prospero and Caliban; Robin Goodfellow; Death of Cardinal Beaufort; Macbeth with the Chaldron of the Witches.

For farther information respecting this eminent painter, see Malone's Life of him, prefixed to his edition of Sir Joshua's works, Northcote's *Memoirs of Sir Joshua Reynolds*, Pilkington's *Dictionary*, Supplement, and Chalmers's *Biographical Dictionary*, vol. xxvi. p. 152.

RHEIMS, an ancient city of France, and in the department of the Marne, is situated in a plain on the banks of the small river Vesle. The city is of an oblong form, and is surrounded with a ditch and earthen mound, planted with double rows of trees on both sides. The walls with which it is surrounded are by no means strong. The lower half of the wall seems in many places to be common stone, and the upper half chalk stone. The streets are generally straight, and wide, and clean; and the houses well built. The principal street passes nearly in a straight line from the eastern to the western gate, through the Place Royale. There are six gates to the town, which have a fine appearance in entering them, from the grand avenues of trees which lead to the town. One of them is called the Pont de Mars, and another the Porte de Ceres.

The Place Royale, which is nearly in the centre of the town, is a very handsome square, with very elegant houses. In the centre of the square stands a short and thick frustum of a marble column, with two huge statues of bronze at its base, one of which represents Commerce, and the other Force, with a lion at its side.

Rheims.

One side of the square is occupied by the customhouse, which is an elegant building It is three stories high, and has an avant corps of four Doric columns, supporting a sculptured pediment. It has twelve windows in front. Those in the lowest story have circular heads, and between each of the upper ones is a Doric pilaster. A balustrade terminates the front above.

The cathedral, which is one of the finest specimens of Gothic architecture in France, is a work of the 12th century, and is in every respect a grand and imposing edifice. It is also famous in history as the place where the ceremony of anointing or consecrating the kings of France took place. At the west end of it, which has a general likeness to that of Notre Dame in Paris, there are three noble entrances loaded with full length statues below, and smaller ones above, inclined according to the curvature of the pointed arches which compose each entrance. The middle portal had, before 1814, undergone some repairs, which gave it the appearance of being new. Above the middle door there is a large circular window, with another of the same form above it. At the west end there are two lofty and highly ornamented turrets, which are mutilated above, having the appearance of being unfinished. There are seven flying buttresses between the transept and the end of the nave, and in each buttress there is a niche, or rather a recess with columns, containing a full length statue. Above the buttresses, on the top of the principal wall, there is a singularly light balustrade of pointed arches, which appear projected against the roof. At the east end of the cathedral, which is circular, there are quadruple flying buttresses, and above them an aiguille or small spire. The two gates on the north side of the transept have their fine sculptures in great preservation. The third gate has the appearance of having been built up.

The interior of the cathedral corresponds in magnificence with its external architecture. There are ten noble Gothic columns in the nave on each side, one window being between each two pillars. The places in the roof where the groins meet are all gilt. The upper windows in the nave are most beautifully coloured, and the lower part is adorned with twelve pieces of fine tapestry. A large and finely sculptured marble tomb, representing the killing of a lion, was, in 1814, standing upon stones in a temporary position.

In the choir there are ten columns having their capitals beautifully wrought. Six of these are circular. The aisles are all very grand, particularly five of them behind the choir, which are each adorned with temples of four fine marble columns. In the north end of the transept there is a fine organ. There is a grand circular window of coloured glass above it, and another on the opposite side.

The archbishop's palace, which is a large building, is situated close to the cathedral. It bears the date of 1690, and seems to have been used as a caserne.

The church of St. Remi, situated in the higher part of the town, is seen at a great distance, with its three lofty spires, in approaching the town from Chalons. The spire at the east end is the largest and finest. It has a small pyramid at each angle, joined by flying buttresses to the principal pyramid. The two spires at the west end are similar, but without buttresses. There is a large circular iron window at the west portal, with fluted columns all the way up the front. The south portal is grand, but a little defaced. In the north end of the transept is a circular window, and in the south end a large window, in both of which there is very little coloured glass. The outside of this church is not remarkable for ornament or fine architecture. It has a fine chime of music-bells. The interior of the church is very fine. There are side aisles all around. In the choir there are ten large massy columns, and the upper windows of it consist of beautifully painted glass. Between each column in the choir are two marble columns and two pilasters, and in one of them three marble columns. There is an altar-piece behind with two black marble columns, and the nave is ornamented with six pieces of tapestry. Across the transept, on each side, there are eighteen little marble columns of black and red marble, alternately supporting an architrave. In the choir a grand circular mausoleum is erected over the tomb of St. Remi. It consists of eight large marble columns, with segments of arches springing from each to an apex above. It contains within it no fewer than fifteen full length marble statues of the Bishops of Noyon, Chalons, Beauvais, Langres, Laon, Rheims, Burgundy, Normandy, the Duke of Aquitaine, the Counts of Champagne, Flandre, and Thoulouse, besides other three figures without names. All these figures surround the tomb of St. Remi. This mausoleum was erected in 1803 by M. Remi-Roland Ladinard of Vauxcelles. There was standing in the nave in 1814 a huge gilt ball, surmounted with an eagle, with the inscription of *Protegente Napoleone Magno.* It is now reversed, and seems to have been one of the ornaments of the church.

The Maison de Ville is a large and handsome building, but only one half of the middle, and one of the wings were finished in 1814. There are eight windows in the half front, two stories and an attic in the body, and three stories and an attic in the wing. It is ornamented with fine Doric pillars below, there being six in the portal, six in the body, and four in the wing. It has a low eight-sided spire, covered with slate. The front of the building was in 1814 undergoing a repair with the chissel. There are three hospitals in Rheims, and some antiquities. The remains of a triumphal arch and some vestiges of an amphitheatre are to be seen without the gate of Mars.

A royal college or high school has been established in place of the university, which was founded here in 1547.

The principal manufactures of Rheims are cotton and woollen, and silken goods, hats and stockings, candles and spiced bread. The Archbishop of Rheims is primate of all France. Population 31,356. East Long. 4° 6′. North Lat. 49° 16′.

RHEINFELDEN, a small town in the north of Switzerland, situated on the Rhine, about nine miles above Basle. It is surrounded with very lofty but miserable looking walls. The bridge over the Rhine at this town consists of a small covered wooden bridge of four arches, which reach to an island covered with the remains of an old building, and another of three arches with stone piers. The Rhine is navigable in boats from this to Basle, and the passage is performed in an hour and a quarter. The number of houses is about 200, and the population about 1200.

RHEINTHAL, or the valley of the Rhine, is the name of a district of the Swiss canton of St. Gall, extending along the Rhine from the Lake of Constance to the lordship of Sax. It is divided into the Upper and the Lower Rheinthal. It is about eight leagues long, and varies from one, two, to three leagues in breadth. It is separated from Germany and the Rhine. The country, which is very fertile, produces good wine. It possesses very fine quarries, and there are mineral springs at Rebstein, Balgach, Koeblweiss and Thal.

Rhine.

The inhabitants are occupied in winter in spinning lint and embroidering muslin; and there are several manufactories of linen cloths, cottons, and muslins. The majority of the people are Protestants; but there are many Catholics, and in some places they are said to use the same church. In the Lower Rheinthal is Rheinegg the capital, a well-built and agreeably situated town, with some fine public buildings and a considerable trade. The inhabitants of the town are all Protestants. At Thal there is one of the finest views in all Switzerland, commanding the lake of Constance, the Rhine, and a great part of Switzerland and Suabia. In the Upper Rheinthal there are several considerable villages; and Altstetten, a small town, finely situated, has some trade. Population about 14,000.

RHENI, Guido, an eminent painter of the Lombard school, and a disciple of the Caraccis, was born at Bologna, in the year 1574. He acquired the principles of his art from Denis Calvert, a Flemish painter of considerable celebrity; but he afterwards studied under the Caracci, and followed the style of Ludovici, in preference to that of Annibal Caracci. Guido next went to Rome, where he studied the works of Raphael with the greatest ardour; but he was attracted by the works of Caravaggio, and would have followed his style had not Annibal Caracci persuaded him to begin a style of a different kind, in which he perfectly succeeded.

Guido's works became favourites with the public, and he soon rose to honour and wealth. The vice of gaming, however, in which he began to indulge, after he had passed the middle period of life, reduced him to poverty and disgrace, and he died in the year 1641.

There are between thirty and forty of his pictures in he Louvre, and there are many of his works in Engand. Some account of his pictures and of his style has lready been given under the article Painting, Vol. XVI. p. 246.

RHINE, the third river in Europe in point of size, has its origin in the part of the Grissons called the Upper League. Mount Adula, which occupies all the ountry called Rheinwald, and which stretches its oots into all the districts around under different names, orm three small rivers, one of which, from the west, ssues from Mount Crispalt, and is called by the Germans *Forder-Rhein*, and by the French the Low Rhine. The second, which issues from Mount St. Barnabas, is alled *Luckmanierberg*, and the Middle Rhine, and the hird, which flows from St. Bernardin, is called the *Vogalberg*, and the Upper Rhine.

A little to the west there rise four considerable rivers, iz. the Rhone, the Tesino, the Reuss, and the Aar.

The Rhine separates Suabia from Alsace, waters the ircle of the Upper Rhine, and that of Westphalia. It fterwards divides itself into two branches, the left of which is called the Vahal, and the right preserves its ame. At eight leagues below Arnheim it divides itelf again into two branches, the principal one of which takes the name of Leck, and joins the Meuse. The other, which preserves the name of the Rhine, is nly a branch, and falls into the sea below Leyden.

The Rhine becomes navigable at Coire, in the Grisons, nd receives in its progress several navigable rivers. t receives the Aar above Zurich; the Necker at Manheim; the Mein at Mayence; the Lahn near Oberlahnstein; the Moselle at Coblentz; the Roer at Duisourg, and the Lippe at Wesel. The Rhine enters into he Lake of Constance a little below Rheinegg, and it lows out of it at Stein. At Lauffen, below Schaffhauen, it forms a grand cataract about 150 feet high, and another of less magnitude below the bridge at Lauffenbourg. Near Binjen, in the states of Mayence, and near Gourshausen, in the states of Hesse, it forms gulfs or whirlpools of great danger.

The scenery on the banks of this fine river is characterised in some places by great picturesque beauty; in other places by sublimity and grandeur, and in others by the interest of historical associations. The first class of beauties occur principally, though not solely, during its course through Switzerland; the second appear in the grandeur of its falls and its gulfs; and the third are particularly displayed in that beautiful portion of its course from Mentz to Cologne. Here it rolls its waters through the finest part of Germany. Ancient castles, and wealthy towns, and thriving villages, mark its progress; hills clothed with rich vineyards rise in luxuriant beauty from its banks, and the strongholds of feudal and barbarous ages frown in ruined grandeur over its precipices and its floods.

The waters of the Rhine are considerably pure, and are of an olive green colour, while those of the Danube are yellowish, and those of the Rhone sky-blue.

Small scales of gold have been found occasionally in the sand of the Rhine after its floods, and are carefully collected by the inhabitants of the islands on the river. The proprietors farm this right, as well as that of catching the fish which abound in the Rhine.

The course of the Rhine is about 700 miles. In the early part of its course it flows with great rapidity, but it afterwards becomes deep, and slow in its motion. The navigation of the Rhine is by no means easy. The boats of the first size, between Strasbourg and Cologne, carry from 2600 to 3000 quintals; one of the second size from 1200 to 1500; and one of the third, called an Anhang, from 600 to 1000. They are generally drawn by horses, and in favourable winds they use the sail. Steam boats have been recently introduced in the lower parts of the Rhine.

From a variety of accurate experiments made by the celebrated engineer M. Escher, the annual discharge of the Rhine at Basle is, 1,046,763,676,000 cubic feet, which is more than ten times the quantity which the river Tay discharges at the Bridge of Perth. See Physical Geography, Vol. XVI. p. 520.

A full and interesting account of the navigation of the Rhine from Mayence to Coblentz, will be found in Reichard's *Guide des Voyageurs*, tom. ii. p. 197; and in *Voyage sur le Rhin depuis Mayence jusqu'a Dusseldorf*, 2 tom. Neuwied, 1791.

RHINE, Confederation of the. See Confederation of the Rhine, Vol. VII. p. 115.

RHINE, Lower, the name of a department of the north-east of France. It is an oblong tract, bounded by the Rhine on the east, and by the Vosges mountains on the west. It covers about 5675 square kilometers, or 288 leagues. It is diversified with hills, forests, and picturesque and well-cultivated valleys. The soil produces wheat, barley, oats, flax, hemp, tobacco, madder, and rape seed. In the mountains, there are mines of iron, lead, copper, and coal. The pasturage is extensive; and vines grow on the warm exposures. Several canals, particularly that of Brusch, made by Vauban in 1681, serve to water the meadows, to drive the mills, and to convey to Strasburg the timber of the Upper Rhine. The rivers which water it are the Rhine, the Ill, and the Lauter. The principal manufactures are hardware, and linen, besides those of glass, pottery, china ware, and paper. The chief towns are

	Population.
Strasburg, - - - -	49,056
Weissemburg, - - -	4097
Barr, - - - -	3996
Saverne, - - -	3980

Strasburg is the chief place of the department. The forests, of which one half belong to the nation, cover 380,000 acres. The contributions in the year 1803 were 3,609,442 francs. Population 444,858. See STRASBURG.

RHINE, UPPER, is a department in the north-east of France, bounded on the east by the Rhine, and on the west by the Vosges mountains. It occupies about 6030 square kilometers, or 305 square leagues. The soil is stony on the mountains, but rich and fertile in the valleys. The principal productions are corn, hemp, flax, rape seed, wines, and tobacco. Cherry water is a liquor exported in considerable quantities. The mountains produce iron and coal, and a little copper, lead, silver and antimony. About 1000 tons of coal are annually wrought, and about 5080 of iron. There are several canals, and two small lakes in the department. The principal rivers are the Rhine, the Lauter, the Byrse, and the Hall. The manufactures are principally linen, woollen, and cotton goods, and also some paper, leather, and glass. The chief towns are

	Population.
Colmar, - -	13,396
Befort, - - -	4,400
Porentrui, - - -	2,032
Altkirch, - - -	1,720
Delemont, - - -	902

Colmar is the chief place of the department. The forests, of which about a fourth part belong to the nation, occupy about 212,000 hectares, or about 400 acres. The contributions in 1803 were 2,837,063 francs. Population 382,285.

RHINE AND MOSELLE, the name of a department in the north-east of France, is bounded on the east by the right bank of the Rhine; on the north, by the department of the Roer; on the west, by that of the Sarre; and on the south, by that of Tonerre. Though this department is mountainous, yet it is very fertile. Corn is abundant, and sells at a low price. Several excellent wines are produced on the banks of the Rhine. There are mineral waters at Tinstein; and the salt springs of Simmern are said to bring in about 220,000 francs to the nation. Coal is also obtained here. The principal rivers are the Rhine, the Moselle, the Simmern, and the Ahr. The chief places of the department are,

	Population.
Coblentz, - - -	10,000
Bonne, - - -	8,837
Simmern, - - -	1,467

Coblentz is the capital of the department. The forests occupy about 200,000 acres. The contributions in 1803 were 1,717,493 francs. Population 203,290.

RHINOCEROS, see MAZOLOGY, Vol. XIII. p. 449.

RHODE ISLAND, one of the United States of North America, including Rhode Island and Providence Plantation, is bounded on the south, by the Atlantic; on the east and north, by Massachusets; and on the west, by Connecticut. It is forty-nine miles long from north to south, and thirty-seven miles at its greatest width; containing about 1580 square miles; of which ninety are islands, and 190 are covered with water.

The political divisions of the state were as follows in 1810:

Counties.		Population.	Chief Towns.	Population.
Bristol,	3	5972.	Bristol,	2692
Kent,	4	9835	Warwick,	
Newport,	7	16,394	Newport,	7,907
Providence,	10	29,769	Providence,	10,071
Washington,	7	14,962	S. Kingston,	
	21	76,931		

The surface of this state is low, except in the N. W. of the township of Bristol, in which is Mount Haup. The soil, though not fertile, is fitted for all the vegetable products of New England. The principal crops are Indian corn, rye, barley, and oats. Wheat is also cultivated. The pasture is fine, and has fed neat cattle with a weight of about 1700 lbs. About 30,000 sheep are reared in the fold, and the butter and cheese is excellent. In the Narranganset track, there is a breed of pacing horses, which are celebrated for their speed and vigour. The value of lands and houses in 1814 was 21,567,020 dollars.

The mineral productions of the territory are iron ore, copper ore, abundance of limestone, marble, serpentine, loadstone, and some coal. The best frequented mineral spring is near the town of Providence. The following list shows the state of the manufactures in 1810.

	Quantity.	Value.
Salt, -	800 bushels.	600 dollars.
Cotton mills, -	17 mills and 51000 lbs. of yarn,	
Weaving looms,	11,000 looms,	
Hats, - -	50,000 -	250,000
Flax seed oil, -	9560 gallons,	11,950
Spirits, -	1,193,398 gallons,	848,240
Currant wine, -	75 barrels,	4,990
Bark, - -	2 mills,	
Paper, -	14,625 reams,	53,297
Cable and cordage,	545 tons,	163,500
Paper, stamped,	8,000 pieces,	8,000
Straw bonnets,	87,120 bonnets,	25,000
Grist and saw mills,	58,000.	

The total value of manufactures in 1810 was 3,138,356.

Rhode island supports 600 vessels for its foreign commerce. Its exports are barley, grain, flax seed, spirits, horses, cattle, sheep, beef, pork, fish, poultry, cheese, cyder, cottons, linens, sail cloth, bar and sheet iron, sails, anchors, &c. The imports are the manufactures of Europe and India, West India produce, and logwood from Honduras. The value of the exports was

1791, - - -	470,131 dollars.
1802, - - -	2,433,263
1810, - - -	1,331,576
1816, - - -	612,794

The principal rivers are Providence and Taunton, which flow into Narranganset bay. The former is navigable for vessels of 900 tons to the town of Providence; and the latter is navigable for small vessels to Taunton. The chief bays are Narranganset bay, the mouth of which is sixteen miles wide; Greenwich bay, and Haup bay; Point Judith Pond and Providence bay, between one and three miles wide. The principal islands are Rhode Island, Block Island, about seven miles long and four broad; Cannonient Island, ten miles long and one broad; and Prudence Island, six miles long and one broad.

The shores abound with cod, halibut, mackerel, haddock, bass, and perch; and the rivers and bays with sheep s head shad, and herring. The cod fish, *Tetradon testudinus*, exhibits a singular property. When placed alone on the ground, it draws in air by its mouth, till it changes from an oblong to a round shape, a change which the fish accompanies with a grunting noise. When plunged in the water it resumes its proper shape.

A college was founded at Warren in 1764, but was removed to Providence in 1770; in 1804, it was called Brown's University, from one of its benefactors. In 1811, the students were 130, and the graduates 47. Academies have been established in the principal towns. There are thirty-one banks in the state. The principal towns are Providence, Newport, Bristol, Warren, South Kingston, East Greenwich, and Smithfield.

Providence is situated on both sides of Providence river, thirty-five miles from the sea. It is a well-built and flourishing town, with an elegant bridge ninety feet broad across the river. The public buildings are a court house, a gaol, a university, already mentioned, a public library of 2000 volumes; five public schools, seven banks, and eight churches. There are four cotton factories, a large woollen one, a paper mill, and a company for bleaching and dyeing. Three newspapers are published here.

The population of Rhode Island is as follows:

1730,	17,935, including	2,633 blacks.
1761,	40,636,	4,373
1783,	51,899,	3,361
1800,	69,122,	3,407 free blacks, and 948 slaves.
1810,	76,931,	3,609 and 108 slaves.

See Callender's *History of Rhode Island*, 1738; and Warden's *Account of the United States*, Vol. i. chap. xi. p. 456.

RHODES is the name of an island in the Mediterranean, near the coast of Asia Minor, and forming part of the Turkish empire. This island, which was one of the most celebrated of the Grecian states, and rendered illustrious by its commercial wealth, as well as by its naval greatness, forms now a very insignificant portion of the globe. The island is about 12 leagues long from north to south, about 6 broad, and about 44 in circuit. Its form is nearly triangular, and was hence called *Trinacria*.

The land rises gradually from the sea; and from the excellence of the climate, and the fertility of the soil, produces abundant crops. No agricultural skill, however, is employed to aid the natural fertility of the soil, so that weeds and useless plants occupy the place of corn and olives. A tract of low hills next appears, which still produces some of the celebrated perfumed wines of the island, and a range of mountains succeeds, thinly covered with those fine forests which furnished the wood for the ships of the ancient Rhodians. In the centre of that range rises the steep and lofty summit of Mount Artemira, which commands a prospect of all the surrounding sea and coasts.

As neither the corn nor the olives raised in the island are sufficient for its consumption, both are imported to a considerable extent. The quantity of cotton cultivated is scarcely sufficient for the wants of the people. Wine, figs, and other fruits, are exported in considerable quantities.

The climate of this island is every way delightful. The air is salubrious.—"Every gale is scented," says Dr. Clarke, "with powerful fragrance, wafted from groves of orange and citron trees. Numberless aromatic herbs exhale, at the same time, such profuse odour, that the whole atmosphere seems impregnated with a spicy perfume." Hardly a day passes in which the sun is not visible. The winds vary little. They blow from the north or north-west during almost every month, and with some violence. The heats of summer are by no means intense. Hot winds, however, blow from Caramania, in June and July. The winters are wet and mild. According to Savary, the population is distributed in the following manner; Rhodes, the capital, is inhabited chiefly by Turks. Five villages are occupied by Musselmen. Five towns, and 41 villages, are inhabited by Greeks. The families he reckons at 4700 Turkish families, 2500 Greek families, 100 families of Jews, making in all 7300, which will give a population of 736,500. Mr. Turner estimates the Greeks at 14,000, occupying 42 villages; and he says that the remaining 6000, consisting of Turks and Jews, inhabit the capital. The remittances to Constantinople are considered to be about £6300.

Lindus, now Lindo, the ancient capital of Rhodes, and one of the three cities alluded to by Homer, (Il. B. 668.) has been little visited by travellers. Dr. Clarke learned that there existed there the ruins of a temple, which may have stood on the site of the fane, originally consecrated to the Lindian Minerva by the daughters of Danaus. Many inscriptions were observed, one of which given by Dr. Clarke, contains some evidence respecting the position of the ancient city. Vases of great antiquity were dug up in the garden. By travelling on mules, Lindus is not more than one long day's journey from Rhodes.

The island of Rhodes is reduced to the greatest wretchedness by the oppressions of the Turks. The capitation tax is 30 piastres per house. The natives are compelled to labour for the government for little or no pay during three months of the year.

RHODES, the capital of the above island of the same name, is agreeably situated at the extremity of a promontory, and on the side of a hill. The streets and houses are disposed in the form of an amphitheatre, and when seen from the harbour (a view which Dr. Clarke has given,) it has a most imposing appearance, from the apparent massiveness of its walls, and from its lofty towers situated upon rocks. The traveller, however, is disappointed on entering the town. The streets are narrow and irregular, and the edifices destitute of elegance and symmetry. One half of the houses are in ruins in the city, and as many in the suburbs are uninhabited. Among the modern streets, the best and the most spacious one is the Jews quarter. The suburbs, inhabited by the Greeks, are very fine, and consist of good stone houses, with gardens. The principal public buildings are the church of St. John, the palace of the Grand Master, and a convent, all Gothic. The churches are of course turned into mosques, and a large hospital into a granary. The old palace is a large and handsome building.

"The principal ruins at Rhodes," says Dr. Clarke, "are not of earlier date than the residence of the Knights of Malta. The remains of their fine old fortresses still exhibit a venerable moated castle, of great size and strength, so fortified as to seem almost impregnable. It appears a complete system of fortification, combining dikes and drawbridges, battlements and bastions. The cells of the Knights are yet entire, forming a street within the works; and near these cells is the cathedral or chapel, whose wooden doors, curiously carved, and said to have been wrought of an incorruptible kind of cedar, have been preserved in their original state. The arms of England and France appear sculptured upon the wall. The Turks have converted the sanctuary into a magazine for military stores."

Dr. Clarke has published various inscriptions of Rhodes, which he noticed principally on marble altars.

There occurs annually at Rhodes the ceremony of carrying Silenus in procession. A troop of boys covered with garlands, draw along in a car a fat old man, attended with great pomp. Rhodes has two harbours, the old and the new. Dr. Clarke describes the mouth of the old harbour as so choaked with ruins that small vessels alone are able to enter. The two extremities of the harbour are defended by towers about 800 feet distant; and in the centre of the mole there is a square tower 120 feet high. There are here yards for ship-building, but they are little used. The timber is brought from the fine forests of Caramania. The most northern of the inner harbours is called Ters-haneh, or the arsenal, and is reserved for the bey's vessels. It has two transverse piers, but they are in a ruinous state; and in the narrow entrance between them there are only eight or nine feet of water, though they are three fathoms wide. In 1811, Captain Beaufort saw a thirty-six gun frigate on the stocks, built of fir from the mountains near Makry. The other harbour is generally full of merchant ships, which moor with a hawser to the quays, and an outer anchor in four or five fathoms; but a north-east wind sends in a heavy sea. This harbour has also a transverse pier, with an opening at each end; but the water in that part of it is very shallow. There is here a convenient fountain for watering. Rusk, wine, and other refreshments are easily procured through the consul. The principal source of wealth among the inhabitants consists in the number of vessels which land here in coming from the Archipelago to the eastward.

The great colossal statue of Rhodes is supposed by M. de Caylus and others to have stood at some distance from the sea. Pliny mentions a hundred other colossuses which were placed in different quarters of the city. The colossus of the sun, as the principal one was called, was the production of an artist of Lindus. It was above 100 feet high and 720,000 lb. weight. It was thrown down by an earthquake; and it was not till the year 672 that the bronze was carried off by the Arabs after taking it to pieces. East Long. 28° 12′ 15″. North Lat. 36° 26′.

See Savary's *Letters on Greece;* and Sonnini's *Travels in Greece and Turkey*, p. 88—108; Clarke's *Travels*, vol. ii. p. 221—230; and Captain Beaufort's *Memoir of a Survey of the Coast of Caramania*, 1820, p. i.

RHODEZ, or Rodes, a town of France, and capital of the department of the Avignon, is situated on a rising ground near the river Aveyron. The streets are narrow and dark, and the houses of an ancient aspect. It has two squares, and the cathedral, which is handsome, and has a steeple of great height, is the chief public building. There are also here a lyceum, a public library, and an exchange. The principal manufactures are cloth, gloves, leather, and candles, and some of copper. Population 6233. East Long. 2° 34′ 29″. North Lat. 44° 21′ 8″.

RHODIUM. See Chemistry, Vol. VI. p. 20—89.

RHONE, a large river of Europe, which rises at the foot of Mount Furca, in the centre of Switzerland, a few miles only from the source of the Rhine. After passing through the Valais (the valley of the Rhone,) and receiving various tributary streams, it enters the lake of Geneva with a soapy blue tinge, and again issues from the lake in a pure sky-blue stream at Geneva. It now takes a southern course, separating France from Savoy; and when it comes to St. Cenis, it turns to the north-west, and then to the west, till it reaches Lyons, where it is joined by the large stream of the Saone, after forming the tongue of land upon which that fine city is built. Near Lyons the Rhone flows nearly due south: and after receiving the Isere, a little to the north of Valois, and the Durance, a little to the north of Avignon, rivers which descend from the western side of the Alps, it divides itself into two distinct branches below Arles; one of which turning to the west, and then to the south, and forming the southern extremity of the department of Herault, discharges itself below Aigues Mortes into the gulf of Lyons in the Mediterranean. The other branch, which is the largest, reaches the sea more directly by six channels, into which it divides itself, but which have a common embouchure below the island of Camargue, which they surround before they fall into the gulf of Lyons, having performed a course of about 500 miles. The Rhone is always largest in the summer season, from the melting of the Alpine rivers. It is the largest river in France, and the most rapid in Europe. It is easily navigated in the direction of its stream; but mechanical power such as steam, or that of horses, is necessary against the current.

One of the most interesting phenomena of rivers is exhibited by the Rhone at that part of its course, where it loses itself under ground more than once. These phenomena, known by the name of the *Pertes du Rhone*, take place near Bellegarde, between Lyons and Geneva, and about sixteen miles from the latter city. In January, when the Rhone is very small, from not being supplied by the Glaciers, there is only one place where it loses itself under ground. When the river is at a greater height, it loses itself at another place, and when it is still higher, there is a third place where it disappears. At very great floods, the water runs over the places where the river in ordinary states of its waters has disappeared; so that there is then no appearance of the pertes, though a great part of the river actually goes under ground as before.

On the 5th September 1814, when we had the satisfaction of examining this curious phenomenon, the water did not all disappear at the first perte, and it was even boiling up with great fury at the third perte. Below the third perte, a new stone bridge has lately been thrown over the channel, and a little way below the bridge, the Rhone re-appears with great fury. A wooden bridge had formerly been erected between the first and second pertes, but it was carried off by the river. The channel between the first and second pertes was once roofed over naturally with rock; but the roof was cut away, as the place had become the receptacle of smuggled goods.

RHONE, the name of a department in the south-east of France, including the former province of Lyonnois, bounded on the north and west by the departments of the Saone and Loire, on the south and west by that of the Doire, on the south and east by the Isere, and on the east by the Ain. It has an area of 2935 square kilometers, or 148 square leagues. The surface of the department is somewhat mountainous; and its climate is so variable in temperature, that vegetation is slow and backward in every part. The grain which it yields is not one-third of what is wanted for its own consumption. Potatoes, which are grown in

Richardson.

great quantities, are the principal food of the country people. The wines of the department are very abundant, and in general highly esteemed. Those chiefly in request, are from the vineyards situated along the Saone to the right of the Rhone, viz. Cote-Rotie, Chassagre, Millery, and Sainte Foix. The inhabitants of the mountainous parts spin and weave cotton. Iron, copper, lead, coal, marble, and freestone, are the several productions of the department. The following are the chief towns:—

	Population.
Lyon,	109,500
Villefranche,	5000

Lyon is the chief town of the department, and has already been fully described. At Villefranche there is a manufacture of linen cloths called *Toiles de Beaujolois.* There are only about 23,000 acres of wood in this department. The contributions in the year 1803 were 4,391,838 francs.

RHONE, MOUTHS OF THE, BOUCHES DE RHONE, is the name of a department in the south of France, formed out of the dioceses of Arles, Aix, and Marseilles, and bounded on the north by the department of Vaucluse, on the west by that of the Gard, on the south by the sea, and on the east by that of the Var. Its area is 5315 square kilometers, or 266 square miles. The principal productions of the department are corn, rice, olives, sumach, wool, and silk. In consequence of the severe winters of 1788 and 1789, many of the olive trees have been destroyed, so that the produce is only one-fourth of what it was. The wines of Ciotat, five leagues from Marseilles, are the most celebrated. Wool is exported to the value of L.30,000, and silk to the value of L.40,000. Corn is imported. Iron, alum, vitriol, and marble, are among its mineral productions. The chief towns are,—

	Population.
Marseilles,	111,130
Aix,	23,686
Tarascon,	18,300

Marseilles is the chief place of the department. There are only about 60,000 acres of wood. The contributions in 1803 were 3,612,199 francs.

RHUBARB. See MATERIA MEDICA, Vol. XIII. p. 353.

RICE PAPER, a name very improperly applied to a beautiful white and soft vegetable membrane, belonging to the bread fruit tree, the *Artocarpus incisifolia* of Linneus.

The following observations on its structure, made by Dr. Brewster, are taken from the Edinburgh Journal of Science, No. 3, to which the reader is referred for a drawing of the structure.

"The substance commonly known by the name of *Rice Paper* is brought from China in small pieces, about two inches square, and tinged with various colours. It has been for some time used as an excellent substitute for drawing paper, in the representation of richly coloured insects, and other objects of natural history, and has been employed in this city with still more success in the manufacture of artificial flowers.

"Although rice paper has a general resemblance to a substance formed by art, yet a very slight examination of it with the microscope is sufficient to indicate a vegetable organisation. In order to observe and trace the nature of its structure, it was necessary to give it some degree of transparency; and I expected to accomplish this by the usual process of immersing it in *water* or in *oil* of the same refractive power. This operation, however, instead of increasing the transparency rendered the film more opaque, and suggested the probability that, like Tabasheer, it was filled with air; and that the augmentation of its opacity arose, as in the case of that siliceous concretion, from the partial absorption of the fluid.

"In order to expel the air from the cells in which it seemed to be lodged, I exposed a piece of the rice paper to the influence of boiling olive oil. The heat immediately drove the air in small bubbles from the cells near the margin; but it was with some difficulty that it was forced to quit the interior parts of the film. As the olive oil had now taken the place of the air, and filled all the cells, the film became perfectly transparent, and displayed its vesicular structure when placed under a powerful microscope.

"It will appear from the drawing executed by Mr. Greville, that the rice paper consists of long hexagonal cells, whose length is parallel to the surface of the film; that these cells are filled with air, when the film is in its usual state; and that from this circumstance it derives that peculiar softness which renders it so well adapted for the purposes to which it is applied. When the film is exposed to polarised light, the longitudinal septa of the cells depolarise the light like other vegetable membranes.

"Among the three specimens of rice paper which I have produced, there is *one* from which all the air has been expelled by the boiling oil; *another* in which some of the air bubbles still appear in the vesicles, the air having been only partially expelled by boiling water; and a *third* which is in contact with water without having been deprived of any of its air bubbles.

"Upon mentioning to Mr. Neill the preceding experiments, he informed me that the lady in Edinburgh, Miss Jack, who had employed rice paper with such success in the manufacture of artificial flowers, had learned from her brother, who was in China, that it was a membrane of the bread fruit tree, the *artocarpus incisifolia* of naturalists."

RICHARDSON, SAMUEL, a celebrated novel writer, was born in the county of Derby, in the year 1689. His father, who was a joiner, intended his son for the church; but he was unable to give him any more than an ordinary education at the grammar school. Young Richardson seems to have had an early turn for letter writing; and at an early period of life, was fond of female society. At the age of thirteen, he is said to have been employed by three young women to write their love letters; and to have managed these little transactions with so much discretion, that none of them suspected him.

In the year 1706, he was apprenticed to Mr. John Wilde, a printer, whom he served with assiduity for seven years, devoting the time which others employed in rest and recreation, to the improvement of his mind. When his apprenticeship was finished, he wrought as a journeyman printer for six years; and in 1719, he began business on his own account in a court in Fleet Street. His unemployed time was now occupied in drawing up indices for authors and booksellers, and in writing prefaces and dedications, for which he seems to have then possessed a peculiar talent. In the year 1723, when the Duke of Wharton had stirred up an opposition in the city, Mr. Richardson, though of opposite principles, was intimately connected with him, and even printed his "True Briton." When he saw, however, the real object of the paper, he refused to print it after No. 6; and in consequence of his name not appearing at the paper, he escaped the effects of a decision against some of the numbers which he had printed. He was afterwards occupied in printing the daily Journal, and subsequently the daily Gazetteer. His excellent character, and the friendship of Mr. Speaker Onslow, procured him the lucrative employment of printing the Journals of the House of Commons, of which he executed 26 volumes in folio.

Having been applied to by two booksellers, Mr. Rivington and Mr. Osborne, to write for them a volume of letters, he composed for them his "Familiar Letters to and from several persons upon business and other subjects. In drawing up that little work, which appeared in 1741, he conceived the idea of conveying instructions in writing and acting on occasions of importance, and of composing letters, with the view of teaching young women, when leaving service, how to avoid the snares laid for their chastity. These letters he combined with a true story, and he is said to have thus composed in less than three months, his "Pamela," a novel, in 2 vols. which appeared in 1740, and which was received with extraordinary applause. In one year it went through five editions, and was even recommended from the pulpit. Notwithstanding this great popularity, however, it was loudly blamed by many, for the direct indelicacy of many of its scenes, and even for its general immoral tendency; and Dr. Watts, to whom Richardson had presented the work, did not scruple to inform him that "he understood the ladies complain they cannot read the work without blushing."

The great success of that novel produced a spurious continuation of it, called "Pamela in High Life;" which induced Richardson to give a continuation of his own work in two volumes, but it was in no respect equal to the first, being more a defence of his first work than a continuation of it.

Encouraged by his great and unexpected success, he brought out in 1748 the two first volumes of his Clarissa Harlow. This work stamped our author's fame as a novel writer, and excited an interest, during its progressive appearance, which is not often taken in a tale of fictitious sorrow. Rousseau avers, that nothing was ever written either equal or approaching to it in any language. It was translated into French by the Abbé Prevost, and also by Le Tourneur; into Dutch by Mr. Stinstre; and into German, under the eye of the illustrious Haller.

Mr. Richardson was now desirous of giving his readers an example of a perfect man, uniting the character of the fine gentleman with that of a Christian. Hence he was led to compose his "Sir Charles Grandison," which appeared in 1753, and which was the best work which he wrote. In this work, the character of Clementina has been generally admired. Dr. Warton observes, that he "knew not whether ever the madness of Lear is wrought up and expressed by so many little strokes of nature and passion. It is absolute pedantry," he continues, "to prefer and compare the madness of Orestes in Euripides, with that of Clementina." Notwithstanding this high praise, however, it is admitted by Mrs. Barbauld that even this character is over-wrought, and that our author never knew when to stop, and had a tendency to tediousness and prolixity in all his narratives.

The success of these works, and the profits of his business, added wealth to our author's fame. In 1760, he purchased half of the patent of Law Printer to his Majesty, and carried on that part of the business in conjunction with Miss Lintot, afterwards the wife of Henry Fletcher, Esq. M.P. for Westmoreland.

Richardson was twice married, and had several children, but only four daughters grew up to comfort him in his old age. His nerves, which were naturally weak, were still farther debilitated by the loss of six children, which at last brought on a paralytic disorder. This disease terminated in an apoplexy, which carried him off on the 4th of July, 1761, in the 72d year of his age.

The character of Richardson seems to have been nearly as perfect as any that he ever drew from his imagination. He was plain and simple in his manner, and so modest, that he never attempted to shine in society. He was pious, virtuous, and benevolent, and delighted in every opportunity of doing good to his fellow creatures. In business he was regular and industrious, and left his family in easy circumstances.

Besides several minor productions, which are not worthy of being even mentioned, Richardson wrote No. 97, vol. ii. of the Rambler, which led Dr. Johnson to say in the preamble to it, to style him "an author, from whom the age has received greater favours, who has enlarged the knowledge of human nature, and taught the passions to move at the command of virtue."

The correspondence of Samuel Richardson was published in 1804, in six octavo volumes, enriched with an excellent life of the author, and a criticism on his works, by Mrs. Barbauld. The letters seem to have been most improperly published, and are said to sully the reputation of Richardson as a writer. For a fuller account of our author, see Chalmers' *General Biographical Dictionary*, vol. xxvi. p. 19.

RICHELIEU, Armand du Plessis, a celebrated Prime Minister of France, was born at Paris in 1585. He was educated to the church, and was consecrated Bishop of Luçon at the age of 22. He died in 1642 at the age of 58. A full account of his political life we already have given in our article France, Vol. IX. p. 591, 593, &c. He is said to be the author of the *Testament Politique*, a work in favour of the Catholic church. His "Letters," in 2 vols. 12mo., are said to be interesting.

RICHMAN, George William, a well-known natural philosopher, was born at Pernau in 1711. His father was treasurer to the king of Sweden. He studied at Revel, Halle, and Jena, and was elected a member of the academy of St. Petersburgh in 1735. In 1741 he was chosen extraordinary professor of experimental philosophy, and in 1745 ordinary professor. The new science of electricity soon drew his particular notice; but when engaged, on the 6th of August, 1753, in drawing electricity from the clouds, he was struck dead by the lightning which had entered his apparatus.

An account of this interesting event has been fully given in our article Electricity, Vol. VIII. p. 420.

RICHMOND, a borough and market town of England, in Yorkshire, is situated on a lofty eminence on the banks of the river Swale, which winds in a semicircle round the town. The town, which is built on the southern declivity of the hill, consists of several well-built and well-paved streets, the houses of which are chiefly of freestone. The public buildings are two handsome churches, which are both collegiates, and a good town hall. The market-place is spacious and elegant, and surrounded with good houses.

Richmond Castle, which is grand even in its ruins, stands on the south side of the town overlooking the

Swale, which flows in a deep valley below. On all sides except the north, the ascent to the castle is steep and precipitous. The shell of the keep, which is almost entire, is about 100 feet high, and the walls 11 feet thick. The lower story is supported by a huge pillar of stone in the centre, from which circular arches spring and close in the top. The floors of the two upper rooms are fallen in, and the stair case goes only to the great chamber. There is a ruinous tower in the south east corner of the aisle, containing a gloomy dungeon about 14 feet deep. The castle, which covers nearly six acres, belongs to the Duke of Richmond. The principal manufactures of Richmond are knit yarn stockings and woollen caps; but the want of coal and of water carriage is severely felt. The principal articles of trade are corn and lead. The corn is sent from the corn market to the dales in the moors, where the ground is all in pasture. The lead is conveyed from the mines about 14 miles west of Richmond, and is then sent to Borough Bridge and Yarm. The town is governed by a mayor, recorder, 24 aldermen, and 24 counsellors. It sends two members to parliament, who are chosen by about 270 electors. The Swale is here crossed by a stone bridge. Population in 1821—

Inhabited houses, - - - -	1738
Families, - - - - -	760
Ditto, employed in manufactures, trade, &c. -	615
Males, - - - - - -	1578
Females, - - - - -	1971
Total Population in 1821, - - -	3546

See the *Beauties of England and Wales*, vol. xvi. p. 288.

RICHMOND, a village of England, in the county of Surrey, is delightfully situated on the declivity of an eminence on the south bank of the Thames, which is here 300 feet wide, and is crossed by an elegant bridge of freestone, communicating with Twickenham, having five semi-circular arches. The village has a very irregular form, but the streets are handsome, and the houses well built and elegant. The houses and hotels here are particularly magnificent, and afford the finest accommodation.

The church or chapel of Richmond consists of a nave, aisles, and a chancel, built of brick. There is at the west end a low embattled tower built of white stone and flint in chequers. It contains many monuments, among which are those of Lord Brouncker, Mr. Yates the actor, Robert Lewis, Esq. who, as his epitaph informs us, was such a lover of peace, that "when a dispute began between life and death, gave up the ghost to end the dispute;". James Thomson the poet, whose grave was not indicated till 1792, when the Earl of Buchan put up a brass tablet. A neat theatre has been built on one side of Richmond Green. In Richmond Park there is an observatory, with a mural arch of eight feet radius, and of 140°, a 12 feet zenith sector, an eight feet transit instrument; and a ten feet reflecting telescope by Herschel. In the moveable dome on the summit, there is a good equatorial instrument. This observatory is, we believe, under the direction of Professor Rigaud of Oxford. The summit of the hill, called Richmond Green, is levelled and inclosed, and is surrounded with lofty elms. Richmond Hill is covered with the most elegant mansions, and commands the richest and most extensive prospects. There are very useful charities in this place, which are liberally sustained, and judiciously managed. See the *Beauties of England and Wales*, vol. xiv. p. 194.

RICHMOND, a city of the United States, and the capital of Virginia, is situated exactly at the foot of the falls, on the north side of James river, and about 150 miles from its mouth. It is connected with Manchester, on the opposite side of the river, by a bridge 400 yards long, and there is an excellent bridge over the small creek called Baine's Branch, which divides the lower from the upper part of Richmond. The public buildings are, an episcopal church, a handsome state-house, a court-house and jail, a house for the governor, a penitentiary, an armoury, market houses, a public library, containing about 3000 volumes, a Lancasterian school, and eight chapels. The theatre was burned in December 1811, and along with it the governor of the state, and above 70 other persons. A handsome episcopal church has now been erected upon the site of it, with a monument in front recording the disastrous event. The city contains about 800 brick houses, many of which are handsome, and 600 of wood.

At the armoury of Richmond 4000 muskets are manufactured annually, and during the last war, it supplied the nation with 300 pieces of cannon, 12 and 6 pounders, only one of which burst on trial. In 1815 the legislature voted 100,000 dollars for the support of the armoury, and the establishment of four arsenals. A very great quantity of flour is yearly made at Richmond. A rope work is also established there.

A very considerable trade is carried on between Richmond and New York. Linen made in the mountains is exported to St. Petersburgh; but the principal exports are tobacco, flour, and coal.

The shipping in 1816 amounted to 9943 tons. Steam boats, with transport boats attached, ply on James's river, between Richmond and Norfolk. James's river opens a communication nearly 100 miles long. The Richmond canal stretches six miles along the falls. The lockage is eighty feet, which is accomplished by twelve locks, which form a communication for boats between the basin of the river and tide water. The company by whom this canal was made, are bound to open the communication as far as Pattenborough, 200 miles distant from Richmond. The population is as follows:

1800	5537 inhabitants.
1810	9735
1817	14,333

See Morse's *Geography*; and Warden's *Account of the United States*, vol. ii.

RICINUS. See MATERIA MEDICA, *Index*.

RIFLE GUNS. See GUNMAKING, Vol. X. p. 560.

RIGA, a city of Russia, and the capital of Livonia, is situated about seven miles from the sea, on an extensive plain on the Dwina, and on the gulf of Riga. The city is situated on the right, and the suburbs on the left bank of the river. The streets are narrow and crooked, but the houses, which are generally of stone, are neat. The principal public buildings, &c. are the town house, the exchange, the house of assembly for the states of Livonia, the imperial palace, the cathedral, the imperial lyceum, the arsenal, the hospital of St. George, the church of St. Peter, remarkable for its fine tower, the Russian hospital, the botanic garden, the theatre, the custom-house, and the monument of the incendiaries of Riga. There is also a public library, the museum of Himmsel, and a college. As the Dwina is too wide for an iron or a stone bridge, it is crossed by a floating wooden bridge, 40 feet in breadth, and 2600 in breadth. "A row of piles," says Mr. Coxe, "extends from one shore to the other; each pile is from 25 to 40 feet long, according to the depth of the river; and appears about four feet above the level of the water. To these piles the parts of the bridge are loosely fastened, by means of iron chains fixed to the transverse beams. The bridge rises and falls with the river, and under the wheels of heavy laden carriages it moves as if actuated by a spring." When the frost sets in, the bridge is removed; the piles remaining in the water are forced up by the ice, and conveyed to land, and the whole is again laid down in the spring. The harbour of Riga is commodious and safe, from the width of the river, and from its distance from the sea. The entrance of the river is defended by the fort of Dunaberg.

The principal manufactures of Riga are starch, playing cards, refining of sugar and brandy; and some vessels, particularly coasting ones, are built.

In a commercial point of view, Riga is one of the most important places in the Baltic. By the Dwina, and by a great number of land conveyances in winter, it receives the productions of Livonia, Esthonia, Courland, White Russia, the district of Minsk, Lithuania, and the Ukraine. A great quantity of Russian corn is exported; and the rye and barley of Sweden, Norway, and Holland, pass through it. The flax and hemp are assorted at Riga by experienced persons into several kinds, and the prices of them fixed. The best flax comes from Marienburg, Druja, Sebesk, and Ratiska. The government of Novogorod Seversky furnishes the best hemp; and that which comes from the district of Staradub is particularly valued. The greatest part of the flax and hemp are bought by the English. Riga exports chiefly, through English and Scotch houses, planks, beams, skins, tallow, tar, and pitch. The values of the exports were

In 1790, - - -	6,525,714 rubles.
1804, - - -	12,166,912
1809, - - -	15,547,327

The articles imported are commonly wines, English ales, oils, spiceries, fruits, salt, sugar, coffee, tea, and woollen, cotton, and silk goods. They have amounted to 6, 7, and 8,000,000 rubles. The exports in 1804 were divided as follows:

England, - - -	5,320,522
Holland, - - -	1,358,470
France, - - -	414,875
Spain, - - -	1,550,614
Portugal, - - -	827,135
Italy, - - -	74,290
Prussia, - - -	160,331
Embden, - - -	249,227
Sweden, - - -	654,029
Denmark and Norway, -	993,425
Elsineur, - - -	84,650
Lubeck, - - -	348,629
Rostock, - - -	70,519
Bremen, - - -	61,160

The number of vessels which arrived are between 1000 and 1100 annually, and those which cleared out, from 900 to 1000. Population about 36,000. East Long. 24° 7′ 45″ and north Lat. 56° 5′ 1″. See Coxe's *Travels in Russia, Poland, &c.* vol. ii. p. 241—249; Catteau Calleville's *Tableau de la Mer Baltique*, tom. ii. p. 306—308; Muller *Sammlueger zur Russischer Geschicht*, vol. ix.; and Wiedon *Beschreibung der Stadt Riga*.

RIGHTS, Bill of, is a declaration delivered on the 13th of February, 1688, to the Prince and Princess of Orange, by the two British Houses of Parliament, "asserting and claiming the true and ancient undubitable rights of the people of this kingdom."

RIMINI, anciently *Ariminum*, a town of Italy, in the states of the Church, situated in the Marecchia, near the Gulf of Venice. The town is of considerable size, but gloomy; but the streets are strait. There are several squares in the town, and in the principal one there is a marble fountain, with a statue of Pope Paul V. in the centre of it. In the market-place there is a stone pedestal, with an inscription on it, stating that upon it Caesar had stood and harangued his army after passing the Rubicon. The cathedral, the church of St. Francis, and some others, are ornamented with fine marble taken from the harbour of Rimini, which was once covered with it. The church of St. Francis is a fine building, erected in the fifteenth century, and is adorned with statues, basso relievos, and numerous sculptures. The principal antiquities here are a triumphal arch of Augustus, and an elegant bridge 220 feet long over the Marecchia, consisting of five arches, which was commenced by Augustus and finished by Tiberius. Its communication with the sea is by a canal which is choaked up with sand and mud. Population about 8000. East Long. 12° 32′ 51″ and north Lat. 44° 3′ 43″.

RING, Saturn's. See Astronomy, Index.

RINGS, Coloured, Produced by Thin Plates of Air. See Optics, Vol. XV. p. 561.

RINGS, System of Coloured, as produced by Polarised Light. See Optics, Vol. XV. p. 590, 591.

RIO GRANDE. See Brasil, Vol. IV. p. 427.

RIO DE JANEIRO. See Brasil, Vol. IV. p. 428, 433.

RIO DE LA PLATA. See Buenos Ayres, Vol. V. p. 48; and Physical Geography, Vol. XVI. p. 521.

RIPON, a considerable borough and market town of England in the West Riding of Yorkshire. It stands on a rising ground, between the rivers Ure and Skell, near their junction. The streets are arranged in the form of a square, the larger ones forming the outside of the square, and the smaller streets intersect the middle of it. The market-place forms a very handsome square, and is adorned with an obelisk ninety feet high. Many of the houses are old, but they are in general well built. The collegiate church of Ripon is a large and venerable edifice, exhibiting various changes from the Saxon to the Gothic style. It has the form of a cross, and has at the west end two uniform towers, each 110 feet high, with the great tower of St. Wilfrid in the centre, of the same height. There was formerly a wooden spire upon each of these towers 120 feet high, but they were demolished in 1660, by the fall of the steeple of St. Wilfrid's. This church has been greatly improved and embellished by Dr. Waddilove, the dean of Ripon. In one of the crypts of the church there is a sort of catacomb filled with great numbers of skulls and other bones, which have been gradually collected from the churchyard.

The town-hall, erected in 1801 by Mrs. Allanson, of Studley royal, is a very handsome building, standing in the market-place. The other public buildings and establishments are a free grammar-school, erected in 1553, a public dispensary, a school of industry, 4 hospitals, and a new theatre opened in 1792.

The manufactories of Ripon were formerly woollen cloth, and skins; but both of them have declined. Two cotton mills have been erected; and the trade of the town is facilitated by a canal about 2¼ miles long, from the town to the river Ure. Ripon is governed by a mayor, twelve aldermen, and twenty-four assistants. It sends two members to parliament, who are chosen by about two hundred electors. Over the river

Ure, within a short distance of the town, there is a handsome stone bridge of seventeen arches. Within a little more than a mile of the town there are five other bridges. The population of the parish of Ripon in 1821, was 13,096, and that of the borough and township, 4563. See *the Beauties of England and Wales*, vol. xvi. p. 674.

RIVER, is a stream of fresh water flowing into the sea, or into another river, and formed from springs and from the water which falls from the atmosphere, in rain, dew, hail, or snow; first collected in rills, brooks, and rivulets.

The following is a list of the principal rivers, in the globe, nearly in the order of their magnitude.

Amazons or Maragnon,
Senegal,
Nile,
St. Lawrence,
Hoanho,
Rio de la Plata,
Jennissee,
Mississippi,
Volga,
Oby,
Amoor,
Oronooko,
Ganges,
Euphrates,
Danube,
Don,
Indus,
Dnieper,
Dwina.

River.

The following table of the relative lengths of European rivers has been given by Major Rennel.

	Rivers in Europe.		
Thames,	1	Danube,	7
Rhine,	5¼	Volga,	9½
	Rivers in Asia.		
Indus, probably,	6¾	Oby,	10½
Euphrates,	8½	Amoor,	11
Ganges,	9½	Lena,	11½
Burrumpooter,	9½	Hoanho, (China,)	13½
Non Kien or Ava,	9½	Kian Keu of China,	15½
Jennissee,	10		
	Rivers in Africa.		
Nile,	- - -	12½	
	Rivers in America.		
Mississippi,	8	Amazons.	15¾

The theory of the motion of open canals, and consequently of rivers, has already been given at great length, in our article HYDRODYNAMICS; and under PHYSICAL GEOGRAPHY, the reader will find in great detail all those interesting phenomena respecting rivers which he might have expected under the present head.

ROADS AND HIGHWAYS.

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Roads and Highways.

"NEXT to the genial influence of the seasons, upon which the regular supply of our wants, and a great portion of our comforts so much depend; there is perhaps no circumstance more interesting to men in a civilized state than the perfection of the means of interior communication." This sentiment, quoted in one of the reports of the committee of the House of Commons upon the highways of the kingdom, speaks to the heart and feelings of every one, and marks in a strong point of view, an object, which for the last twenty years, has more especially occupied the British legislature; so that while the field of battle has been oscillating between the extremes of Hamburgh and Rome, and of Madrid and Moscow, the domestic policy of Britain has in no instance been more striking than in opening the country by the formation of numerous roads. If we look comparatively to the map of Europe, the surface of the United Kingdom appears every where intersected with numerous roads, while in other countries they seem to radiate only from their respective capitals. Some years since, the writer of this article made a cursory estimate of the extent of the highways of Great Britain and Ireland, when it appeared, that, independently of an almost incalculable number of parish and private roads, the highways alone extended to about 25,000 miles. Upon a very moderate calculation of the expence of these roads, including bridges and compensation for land, we may state it at the rate of £800 per mile, which is equal to no less than the aggregate sum of twenty millions sterling. Now we may fairly ask, to what branch of political economy can we look for more splendid examples of internal resource? It has been truly said, that until a country is traversed and laid open by roads, its government must be weak, and its people remain in a state of poverty. On a subject of such universal interest as the formation of roads, the mind delights to dwell, while it traces their connexion with the progressive stages of civilization in the occupation of the hamlet, the village, and the city. Perhaps we shall best treat the historical part of our subject by a general reference to roads both at home and abroad.

Roads of the ancients.

In speaking of the roads of other countries, we may observe that a people who have executed such splendid works as those of Egypt and Persia, must to a certain extent have had a system of roads corresponding to their habits, no less perfect than those of later times. The circle of the arts seems to move round, yet doubtless the same portion of mind has existed in every age, though our record or knowledge even of comparatively late periods, has by many perverted chances become extremely imperfect. The territory or jurisdiction of the Greeks and other nations who in early times flourished upon the shores of the Mediterranean was small; and although they achieved works of magnitude with a display of taste which still continues to be the subject of our wonder, and will perhaps ever remain to be consulted as our authorities, yet but little is known of their municipal affairs.

Of the Romans.

But it is far otherwise with the works of the Romans, whose conquests extended to all parts of the then known world. With that nation it was always a primary object to lay open subdued countries with roads to be applied to its future purposes either for obtaining supplies or securing a retreat. Such was the *Aurelian road*, which led from the gate of that name to Milan, and from thence across the Alps by various routes, forming the key to Gaul, and all the nations of the north. In Italy alone, the Romans are said to have laid about 14,000 miles of road. Of these the classic antiquary has been able to reckon many of the principal ways which led from Rome by the different gates, such as the *Appian, Salernian, Flaminian, Ostian, Praenestine, Tiburtine, Triumphal,* and others, varying in extent and importance according to the circumstances of the country through which they passed; and from these again, a vast number of subordinate roads, ramified in every direction. Some remains of these splendid works are still to be seen, though the face of the country in the lapse of ages, and the vicissitudes of time, has undergone such changes, as to leave little more to us than the mere recital of their names.

In the formation of roads, the Romans generally kept a straight line of direction, though at the expence of works of considerable difficulty; at one place performing extensive excavations, at another stretching over valleys by bridges and aqueducts, and boldly piercing the mountain, with under-ground tunnels, as that of Pozzuoli near Naples, cut about half a league through the solid rock, and forming a road-way or aperture of fifteen feet square. But in nothing is our wonder so much excited as at the pains bestowed in preparing a firm bottom for the structure of their roads. In some instances, they built walls of masonry, and strengthened the ground by ramming it with brick, rubbish, gravel, or small stones and flints, on which they laid a course of square blocks of various dimensions, not unfrequently cubes measuring eighteen inches upon their several sides, though the *lengthway* was generally the greatest. The surface of these roads was spacious, firm, and smooth. Many of them had a double row of pavement for carriages going in different directions. These were separated by a causeway in the middle, somewhat raised above the others, and paved with brick for the conveniency of foot passengers. The *Appian way,* so much celebrated by Horace, was originally carried only to Capua, but was afterwards carried to Brundusium by Julius Cæsar, being altogether about 300 British miles in length: it formed one of the most splendid memorials of that emperor's reign, under which about two-thirds of it were executed. This famous road is in many places still quite entire, though understood to have seen its nineteenth century.

In Britain, the remains of the Roman ways are now hardly to be traced. They were generally termed streets, as Watling Street, Theneild Street, Erminage Street, and others. At *Castrum,* or Chester, one of the greatest Roman depots in Britain, some of the old roads are still to be seen, and occasionally compactly built pavements are discovered, with several feet of soil upon them. Roman roads have also been found in different parts of Scotland. A portion of one may still be seen leading from Musselburgh bay to Abercorn, one of their principal stations on the Frith of Forth. A portion of this street, termed the "Fish-wives causeway" leads through the fields from Piershill Barracks towards Portobello. It consists of boulder stones very different in size, and is said closely to resemble some of the old Roman ways still seen in Italy.

The pontiffs and heads of the different Italian states succeeded the munificent reigns of the emperors in the government of this ancient kingdom, and following the established taste of that country for roads, Italy still preserves her celebrity for interior communications. Amidst the misery which the sway of Buonaparte entailed upon the countries on both sides of the Alps, it was fortunate that his measures ultimately tended to facilitate the intercourse between the ancient mistress of the world and the rest of Europe, by the improvement of the great passages across this mountain range, which was effected by the French and the Italians in the years 1804-5. Under the auspices of this great man, the Aurelian road has been thus adapted to the speed of the modern traveller. The track by the Simplon being generally at the rate of one perpendicular to twenty-eight horizontal, the postillion now takes that road, formerly almost impracticable, without requiring to slacken his pace. Among the difficulties to be encountered in the formation of this magnificent undertaking, there are several under-ground tunnels, the longest of which measures about 200 yards. It is curious thus to see the aggregate power of armies under the control of one individual directed to such objects. It is indeed doubtful whether at this moment the fame of the Roman emperors stands higher as conquerors, or for the works of art which they achieved; and we hesitate not to say, that the French Emperor's chief claim to true greatness will be sought for in the works which were executed under his powerful command as a *military engineer.*

The French highways seem to have been modelled upon those of Italy, the great and early prototype of the nations toward the north. The roads which radiate from Paris, like those of Rome, are chiefly chaussées, *causeys,* or causeways. These consist of a bottom or foundation, carefully prepared, and previously drained, on which stones measuring about six, eight, and ten inches square, are set or built, the downward side being in the usual manner somewhat smaller than the upper one. The rock from which these stones are taken is generally quartzy sandstone, of considerable tenacity. The lines of direction of the French roads are for the most part straight, without much regard being paid on many occasions for more easy or favourable lines of draught. They are of a spacious breadth, varying from thirty to sixty feet, even seventy feet; the causewayed part is usually situate in the middle, being about sixteen or eighteen feet in breadth, with a bridle or summer road on each side. Many of the roads of France, however, like those of England, are made with metal or broken stones, a system practised even before the Revolution by the Etats de Languedoc, under the direction of M. Turgoz in Limonsin, &c. which now rather seems to be gaining ground, as forming a road so much smoother, and more agreeable than the irksome noise of the paved road. The chaussée in the middle being somewhat elevated in position, seems entirely to have precluded the idea of a footpath on either side; a comfort which rarely extends beyond the boulevards of the large towns. Nothing indeed surprises an English traveller more than to find Paris, the mistress of politeness, and the admired theatre of the arts, still without this accommodation excepting in a few streets at the Court-end of the town, where a kirb-stone is introduced, lining a somewhat elevated, though roughly causewayed footpath. In all other parts of that otherwise elegant city, the unfortunate pedestrian is left to trudge along under all the indignities of the bespattering *cheval* and his harassing driver, in their traverse course through the kennel in the middle of the street.

The want of cross or parish roads is not peculiar to France; for there seems every where on the continent an almost total oversight with regard to their importance to the best interests of a country. They do not seem yet to have caught the English sentiment, so happily expressed by the late Dr. Anderson in his Rural Recreations. "Around every market place you may suppose a number of concentric circles drawn, within each of which certain articles became marketable, which were not so before, and thus become the sources of wealth and prosperity to many individuals. Diminish the expense of carriage but one farthing, and you widen the circle; you form as it were, a new creation, not only of stones and earth, and trees, and plants, but men also; and what is more, of industry and happiness." In France, notwithstanding the excellency of many of the principal roads, and the science displayed in their construction, the utmost difficulty is experienced in crossing that fine country. In attempting this, you at once get into a range of narrow lanes, beset with luxuriant furze and wild shades, forming no doubt an agreeable shade, but proving, upon the whole, a great annoyance to the traveller as well as to the husbandman. The present state of the continental parish roads forms a complete bar to the numerous advantages which would follow the establishment of some systematic mode of appointing trustees or commissioners from among the country gentlemen, who would then feel a more immediate interest in the internal improvement of their respective neighbourhoods. Such a system would excite a spirit of enterprise, carrying in its train numerous enclosures, drainage, and many local advantages, which in the present close and impracticable state of the country, can neither be foreseen nor undertaken.

We cannot withhold our admiration, however, of the facilities of the traveller on the roads of France. Take away the apparently useless and harassing system of passports, (at least during periods of profound peace,) and upon the French roads you proceed from the one end of the kingdom to the other without annoyance, or the occurrence of a single toll-bar. The same thing takes place with the mariner, who having cleared at one port, may put into any harbour, and enjoy the benefits of all the lights upon the coast without farther trouble; the whole community being considered as one great family; and the establishment for the erection and maintenance of roads, bridges, harbours, and light-houses being under one special board of engineers. This proves also an excellent system for training young gentlemen of talent, who having been placed at the polytechnic school in Paris, are, according to their several propensities and tastes, brought forward as civil and military engineers in all the departments of the French service. The school for civil engineers at Paris is somewhat analogous to our military college at Woolwich; by this means the country is supplied with an organized body of engineers, whose science and conjoined practice insure the systematic performance of all their public works. We cannot help expressing a wish that Britain and France, with regard to this department, were in some measure blended together; that in the road department for example, the French had, in connexion with their professional system, the aid, patrimonial interest, and local knowledge of the country gentlemen.

The roads of Spain and Portugal are generally allowed by travellers to be in a very indifferent state, and devoid of all the more recent improvements. Their direction proceeds with very little regard to the line of draught. Their surface is rough, and their repair but little attended to. The political situation of these countries for the last twenty years has been highly inimical to improvements of this description. They are every where nearer to the sea-coast than France, and have, upon the whole, less dependence upon the state of their roads for the transportation of troops. It has indeed fallen to the lot of few countries during periods of war, to proceed in the advancement of interior communication.

The chaussée, or paved road, similar to that of France, is common in the most populous districts of the German and Prussian dominions; but over a great part of these countries, the roads are little more than formed, being almost without any prepared surface. Hence they are all run into deep tracks, which are extremely inconvenient to travellers; and therefore it becomes necessary, in the different circles or cantons to have different lengths of axles, so that a carriage properly fitted for a journey in Germany, requires that the wheels should be made to shift out and in at pleasure, to suit the tracks of different districts. The improvement of the roads has been undertaken in various parts of these countries; but it must be a work of much time before this can take place very generally.

Roads and Highways.

Holland and the Netherlands.

In Holland the traveller generally betakes himself to the numerous water-ways or canals of the country; but here time and patience are both necessary; for though the canals are spacious, the passage-boats move slowly, and to suit a few trifling bridges by the way, (for they never pass through the towns,) are made so narrow that there is no more than sitting room in their cabins: the traveller's walk through the town, however, accompanying his luggage in a good day, under these circumstances, becomes rather a relaxation. The roads in Holland are generally carried in undeviating straight lines along that low flat country, between a double row of trees, with a great ditch on each side. Upon the tops of the national dykes, which defend the land from the inroads of the sea, the traveller is often upon pretty elevated ground, where his track takes many tortuous directions. The Dutch are at great pains in preparing as firm a foundation for their roads, as the nature of the country will admit. They are then built with thin bricks called *clinkers*, which are laid in lime, their longest direction being across the road; so that a carriage passes along in the same easy manner as if it were upon a railway. The people of Holland are generally reputed to be very slow in their motions; but their land journies are certainly exceptions to this; for in going to market, and even in farming operations, their carts are generally at speed. In the lower parts of the Netherlands, the roads partake a good deal of the Dutch construction, and in the higher parts, the chaussée occurs, which in some districts is laid with the greatest precision, and makes most excellent roads.

Sweden and Russia.

The Swedes have long had the character of being excellent road engineers. Good rock is very generally met with in Sweden; and they spare no pains in breaking it small. Their roads are spacious and smooth; and travelling in all their principal lines, is as easy as on the best roads of England. Where the country has been opened in Russia, the roads are formed on scientific principles; but they bear no comparison to the extent of that vast empire. Hence the unwieldy form of such a country, and the application of the Abbé Raynal's remark, "Let us travel over all the countries of the earth, and wherever we shall find no facility of trading from a city to a town, and from a village to a hamlet, we may pronounce the people to be barbarous; and we shall only be deceived respecting the degree of barbarism."

America.

Roads connected with Mexico and Peru have long existed; and among the other peculiarities of these states, the description of the excellent condition of some of their ancient roads has excited the surprise of Europeans. But the advanced state of this department, like many other earlier accounts of the New World, has been greatly exaggerated. More recent travellers have not been able to discover Montaigne's famous road from Quito to Cursoe, said to have been 300 leagues in length, and 25 paces in breadth, constructed with immensely large stones, with a running stream, and a row of trees upon each side.

In the cultivated parts of North America, the roads have latterly been much improved; and some of the principal lines are similar to the generality of English roads, which in construction they resemble. Along some of the morasses and inland parts of the country roads of some extent are actually made with logs of timber disposed as railways. For bridges, particularly of timber and catenarian arches with chains, the Americans have a considerable name, and have lately executed works of this kind of great extent.

In thus briefly noticing the roads of various countries, the object has not been so much with the expectation of instructing, as with the view of pressing a subject, upon the notice of travellers, which more or less concerns every one, that they may be induced to take notes in the course of their journeys in foreign countries upon a topic, regarding which conversational remarks are so common, though few of them reach the public in a precise and tangible form.

British roads.

In giving an account of the state of British roads and highways, we may take some retrospect of their advancement to a system. The sites of our ancient towns and cities were, for obvious reasons, chosen upon the wooded banks of rivers, where a supply of water and of fuel were conveniently within the reach of the inhabitants, and no doubt, at the period of their foundation, apparently in great abundance. Though the lapse of time may have been sufficient to clear away the forest, and the river or lake may now fall short of the increased wants of their surrounding population; yet in every instance, the evidence of the early existence of these may be traced in the immediate vicinity of all towns and populous districts. The change of circumstances produced by the gradual removal of fuel and building materials from the early settlers is very striking, and has of course given rise to the extension and improvement of interior communication. At a remote period, when each family formed a kind of community within itself for providing the necessaries of life, it is obvious that there could then be little communication with distant parts of the country, and there was therefore no use for roads, which long after the establishment of towns, must have continued in the state of footpaths and horse-tracks. The bulky articles of fuel and building materials are likely to have given the first idea of a sledge, the precursor of the wheel-carriage, and to have led ultimately to the construction of something like a road. As before noticed, our first roads were the military ways of the Romans; and even after the experience of ages, this department cannot by any means be said to be complete in all its details.

England.

The early roads of all new countries are therefore generally directed to the elevated grounds, with a view to avoid the marshes of the valleys, answering very well for bridle-tracks, but extremely inconvenient as carriage-ways: hence, as the habits of a country change, and the lower grounds are drained, the roads progressively get upon lower levels, and as they approach large towns and capital cities, become more spacious, and are made to diverge in all directions. As wealth and establishments are necessarily the precursors of improvements, we are naturally led to look to England for the earliest advancement in the road department. In the year 1285, we find the first law respecting roads and highways, by which it is enacted, that the proprietors of the land shall enlarge and "breadthen the ways where bushes, woods, and ditches be," to prevent robberies, and a train of evils to which the lieges in those days were thereby subject. In 1346 it was enacted, that Edward III. should be enabled to levy a toll on carts and carriages passing from St. Giles' in the Fields to Temple Bar; and also by the road which is now Gray's Inn Lane, both of which had then become impassable. But the famous act of Henry VIII. was the first measure of a general nature upon which all the after-improvements and extension of the road system were founded. By this act, the respective parishes were intrusted with the care of the roads, and surveyors appointed to be annually elected to take charge of them. It soon, however, appeared, that the funds allotted for this purpose were insufficient, and as the traffic of the country extended, the roads became hardly passable, while the several trusts were in a state of bankruptcy. The next measure was therefore to make them all turnpike, and toll-bars were accordingly set up, and those in future who used the roads, were made to contribute directly towards their support, a system which, under various modifications, has hitherto been persevered in. Now the whole face of the country is laid open with carriage ways, placed under various trusts or commissions, and although they have become very general, yet entirely new lines are occasionally formed, besides a constant improvement in the line of draught of the old lines, so that it may truly be said of road-making that it has no end. In England, the agriculture of the country got into a formed and improved state long before wheel-carriages came into general use; and, in this way, the practice of going over the hill is still too often persevered in, when a level, frequently as short, would be obtained by going round its base.

There are many of the great lines of road which, to suit the facilities of modern travelling, still require a general improvement. The union with Ireland gave rise to the extension and improvement of the roads leading to the great ferries at Portpatrick, Holyhead, and Milford, which have severally undergone the latest amendments, especially the Holyhead line of road, passing through North Wales, by Shrewsbury and also by Chester, to London. Connected with these lines, a great bridge of suspension is now (1824) in progress at the straits of Menai, consisting of a catenarian arch of chains extending to 560 feet, between stupendous abutments of masonry; a work which is no less creditable to the British name than to the enterprise of the eminent engineer, Mr. Telford, under whose direction it is executing.

In South Wales a similar policy on the part of the government, will, no doubt, also fall in due time to be acted upon. The ferry between Waterford and Milford-haven, having now got steam-packets, may be made equally efficient with those of Portpatrick and Donaghadee, as it wants only the improvement of the roads through South Wales to complete that communication, which is somewhat shorter than the others to London.

In Ireland, the department of the roads is under the same description of management, by numerous trusts and commissions, as in England. In the beginning of the nineteeth century, the roads of Ireland were, generally speaking, considered in a better condition than those of any other part of the United Kingdom. Here the cross roads are also numerous, and in a tolerable good state of repair. The principal roads are spacious, varying in breadth from thirty to sixty feet, while the ditches and side drains are in many instances kept within the fences, and as the road-metal, consisting of limestone, and a kind of lime-stone gravel, is of good quality, the surface of the Irish roads is in general smooth and hard.

The road-system in Scotland differs considerably in the management from those of England and Ireland. The Scots local trusts are divided into districts, each of which seem to have a more independent control without reference to quarter sessions, as is the case in the other parts of the kingdom. In taking any general view of the roads of Scotland, they may be classed under three distinct heads: First, those of the southern counties, which have been wholly made and maintained by the statute labour and the rates collected at the toll-bars: Secondly, the military roads of the Highlands, made by the troops on the peace establishment, wholly at the expence of the public; and, thirdly, the roads made under the direction of parliamentary commissioners, at the joint expence of the public and the landed interest of the northern counties.

It is to the formation of the two latter classes of these roads that we perhaps owe much of our present taste for road-making throughout the united kingdom. The military roads had their origin in the rebellion of 1715, when it was found that the royal troops could not penetrate farther into the Highlands than Blair in Athol from the total want of roads. "The inhabitants of the Highlands," says Colonel Robert Anstruther's Memorial, included in the Parliamentary Reports, "a hardy race, accustomed from their infancy to arms, devoted to their chiefs, strangers to industry, and secluded from all intercourse with the rest of mankind, as well from their natural situation, as by their dress and language, formed a distinct people from the rest of the empire; and for ages, the government, the country, and the Highlanders, suffered greatly from these distinctions."

About the year 1732, General Wade was appointed, with the several regiments under his command in this district, to make certain roads, which should in future be sufficient for the conveyance of troops and military stores. The first line of road which they formed was from Stirling, across the Grampians, to Inverness, and from thence along the chain of forts, including Fort George, Fort Augustus, and Fort William, between the east and west seas, by which troops and artillery were carried with facility into the central Highlands, and thereby the disturbances of 1745 were speedily suppressed. By the year 1785, the military roads, including what has been termed the Galloway road, from Portpatrick to the river Sark, on the confines of Cumberland, extended to no fewer than about 788 miles, including 1011 bridges; and the light-house of Port Patrick. The improvement of the northern districts of Scotland became a still farther object with government about the year 1803, when a select committee of the House of Commons, among other objects, took under its consideration the farther extension of roads in the Highlands and Islands. Commissioners were appointed by Parliament with power to defray one half of the estimated expence, provided the proprietors of the land advanced the remainder. In this manner, by the year 1814, about 700 miles of road had been made under this commission. At this period, the whole of the military and more recent parliamentary roads of the north, now extending to about 1200 miles, were thrown into one general trust, with power to assess the counties to a certain extent, the government making up the balance of about L.10,000 per annum, as the estimated expence of their maintenance, including ferry piers, landing slips, inspection, and management.

In the history of the road department of Great Britain, one of the most important features of its progress was, the appointment of the committee on the roads and highways of England and Wales in the year 1806. The reports of this committee upon wheel carriages, and the construction of roads in general, are perhaps of the highest importance to our domestic policy ever made to Parliament. These reports contain a mass of information collected from men of the first consideration for scientific and practical knowledge; among whom we notice the names of Jessop, Walker, Cumming, Edgeworth, Ward, Boswell, &c. &c. It is, however, much to be wished, that the important labours of this committee had not terminated till they had proved, by actual experiment, upon the great scale, many of the scientific and elegant theories submitted to its consideration. By such researches, our improvement in roads, and in a more perfect construction of wheel carriages, would have been systematically continued, till we should have realized the ultimate benefits anticipated by the conclusion of the committee; namely, that no less than FIVE MILLIONS sterling might annually be saved to the public by following out the improvement of our road system, under the direction of parliamentary commissioners specially appointed for the highways of the kingdom.

Roads and Highways.

ROAD-MAKING.

From the historical sketch we have given of roads generally, it appears surprising how slowly such improvements advance to anything like perfection in the art. In illustration of this, we may take an example from the military roads above alluded to. Agreeably to the practice even late in the eighteenth century, roads were, in most instances, carried in a direct line, without much regard to the undulating surface of the country. The approaches to some of the most noted passes of the Highlands were so precipitous and difficult as to have been familiarly termed, "Rest and be thankful," "The Devil's Staircase," and the like, where stone seats were actually provided for the use of the hardy pedestrian. At one of these, a celebrated author having inquired at his guide what could have induced the gentlemen who commanded the troops on the service of the military roads to put their designations upon certain tablets set up by the way, he facetiously replied, "I know not, unless it were to afford the weary traveller an opportunity of *cursing* them by name and surname."

Line of direction.

Although in Road-making the Line of direction must always be subordinate to the Line of draught, yet the former is notwithstanding of importance, both as it regards the safety of the traveller, and the trackage of the load. Independently of the numerous accidents which occur, from the sudden collision of carriages travelling at speed upon a tortuous line of road; it were even better to go up a moderate acclivity, than to introduce numerous turns, which, to a certain extent, are not less detrimental to the effective power of the horse, than the up-hill draught. Every turn in the road, which ultimately amounts to a right angle, does in effect, suppose the carriage to have been brought from a state of motion to a state of rest, and from rest to motion again. Turns, in a road where they are unavoidable, ought to be formed on curves of as large a radius as the situation will admit.

In forming or laying out an approach to a mansion-house, we consult our taste, and are neither deterred by the elongation, nor winding direction of the road, in bringing the various objects of an interesting nature into view. In public roads however, this should very rarely enter into the design of the engineer, though other considerations, such as a more easy line of draught, a more suitable tract of ground, or the vicinity of good materials, will sometimes properly induce the adoption of a less direct course. The Roman roads were chiefly laid out in long straight lines, and the engineers of France, and other continental countries, have followed their example more closely than those of Britain. Extensive straight lines are doubtless irksome to the eye, and do not suit the associations connected with the ever-varying "line of beauty." But upon the king's highway, something is undoubtedly due to the ease of the horse. There ought, therefore, in laying out a road, to be a kind of compensating balance between the lines of direction and draught; and wherever weighty reasons occur for varying the direct line, such as an acclivity to be avoided, more proper soil to be obtained, the avoiding of valuable property, or the including of a village or town; where such motives present themselves, the judgment of the engineer will of course be exercised in varying the line of direction.

Line of draught.

One of the most important considerations in practice is the adoption of a proper Line of draught, according to the changing circumstances of the country through which the road passes. Wherever a level line of road can be obtained, it should in our opinion be adopted, regard being had to the drainage of the soil, and the particular form or curve given to the surface of the road. In how very many instances does the scientific engineer, when called on to improve a line of road, carry us along a uniform and easy acclivity, instead of an *intermitting track*, consisting of precipitous heights or abrupt hollows. If, for example, we take the difficult pass of "Rest and be thankful," in Argyleshire, where the road is carried through the pass of Glencrow, along an undulating line of draught, it might, upon leaving Loch Long, be made to rise upon a very gentle and uniform acclivity all the way, admitting, however, of occasional level parts for the relief of the draught. In like manner, on the Loch Fyne side, a much more easy line of draught than the present might be found to the same summit. Similar instances everywhere occur, in travelling over the chalk, lime, and sandstone knolls of the south; one or two of these may also be noticed. On the great north road, perhaps the worst stage between London and Inverness is that between Newcastle and Durham, and here the error might in a great measure be avoided, by merely varying the line of direction. Another instance is upon the great road from London to Ireland, through South Wales by Milford. The stage alluded to is that between Bristol and New-Passage ferry, which is extremely tortuous, both in its line of direciton and draught; although, by keeping along the right bank of the Avon, the road might be shortened, and preserved nearly upon one level.

Opinions about this.

We must not, however, omit to notice that various opinions exist with regard to the most proper line of draught; some think that an undulating line is better than one which is level. As this idea seems to strike at the root of all our road improvements, it will be proper to bestow more attention upon it, than it would otherwise from its obvious nature seem to deserve. It is contended by many, that horses are more fatigued with their load upon a level road, than upon one which goes up and down hill. This view is generally supported by arguments supposed to be derived from the anatomical structure of the horse, and from the various muscles of the body being thus alternately brought into action. But we may notice, that in an uphill draught, a carriage may be conceived as in the state of being continually lifted by increments proportional to its rise or progress upon the road, as already mentioned under the article Railway. We may also show this practically, as every one knows that on a stage of twelve miles the post-boy generally *saves*, as it is termed, at least half an hour upon the level road, because on it he never requires to slacken his pace as in going up-hill. Now, if he, or his company, would agree to take the same time to the level road that they are obliged to do upon the undulating one, the post-master would find no difficulty in determining which side of the argument was in favour of his cattle. With regard to the fatigues or ease of the horse, the writer of this article not having such plain matter-of-fact for his guidance, upon one occasion submitted the subject to the consideration of a medical friend, (Dr. John Barclay, of Edinburgh, no less eminent for his knowledge, than successful as a teacher of the science of comparative anatomy,) when the Doctor made the following answer:

"My acquaintance with the muscles by no means enables me to explain how a horse should be more fatigued by travelling on a road uniformly level, than by travelling over a like space upon one that crosses heights and hollows; but it is demonstrably a false idea, that muscles can alternately rest and come into motion in cases of this kind. The daily practice of ascending heights, it has been said, gives the animal wind, and enlarges his chest. It may also, with equal truth, be affirmed, that many horses lose their wind under this sort of training, and irrecoverably suffer from imprudent attempts to induce such a habit." In short, the Doctor ascribes "much to prejudice originating with the man, continually in quest of variety, rather than the horse, who, consulting only his own ease, seems quite unconscious of Hogarth's Line of Beauty."—*Report on the Edinburgh Railway.*

Due regard having been paid to the lines of direction and draught, the road comes to be formed perhaps through an undulating tract of country, and over a variety of soil, requiring different modes to be specified for its execution. One ruling principle, which should pervade the whole system of the formation of roads, is their thorough drainage. The smaller drains, connected immediately with the road, must vary in their number, direction, and description, according to the judgment of the engineer. They consist of what are technically termed *box* and *rambling* drains; the former of which are built, and the latter consist of a stratum of ruble stones, simply thrown into an excavation made for their reception, through which the moisture is allowed to percolate. Where the road is to be made through a boggy or marshy soil, which is generally pretty level, the opportunities for drainage are less obvious; nor is this so material, as ground of this description is capable of containing a great quantity of water, without endangering the flooding of the road. In such situations it also fortunately happens that land is seldom of much value, and therefore, in making a road through a morass, a much greater breadth should be included between the lateral drains than where the ground has m undulating surface. Attention should also be paid to cut the ditches of a moderate depth, as the tenacity of such soils depends upon their being kept in a somewhat moist state. If a section of such ground be exposed to the sun and air, by deep side cutting, it soon pulverizes, and loses its elasticity, when the level of the road falls, and its surface gets into disorder. The drainage of a road should rather be made across than in a lateral direction, as being less apt to be injured by the traffic upon it. Whatever degree of convexity is given to the cross section of the surface of the road, the same figure should be given to the bed or ground on which the broken stones are to be laid. By this means the drainage will be assisted, and the metal preserved of an equal depth throughout, instead of being thicker in the middle, or under the horse path, than where the carriage wheels travel. By this means also a considerable portion of metal will be saved, especially in situations where it is laid of the whole breadth between the side drains. This is further illustrated by Fig. 4, Plate CCCCLXXX. and its description at the end of this article.

The curve, or top line of the cross section of the road, is also important, and its degree of convexity should be regulated very much by the line of draught, the principal object being to carry off the moisture by surface drainage. But, for this purpose, the declivity from the centre to the sides may be very gentle, it being only wanted to take it off so easily as not to endanger the washing of the pulverized stuff entirely away or rutting the surface. To provide for the rain-water flowing in direct lines from the centre to the sides of the road, would be to *barrel* or round it too much, as was the case formerly, even to a degree that was dangerous for carriages. The cross-section of a level track of road should be elliptical, falling from the centre to the verges on either side, at a rate not exceeding an inch and a half perpendicular to a yard horizontal. But where an acclivity in the line of draught occurs, where carriages are in the greatest danger of being upset, the surface of the road should be kept flat, or with a fall not exceeding three quarters of an inch to the yard, to take the water gently off toward the sides, and prevent it, during heavy rains, from rutting the road in a lateral direction.

It has been complained that many thousand acres of land throughout the kingdom are lost to the agriculturist, from the increased breadth which is now given to our public roads; but this, to say the least, is a very narrow view of legislative policy. Independently of the safety and conveniency of the traffic, the mere consideration of drying the road by more speedy evaporation is a sufficient reason for preserving a spacious breadth in the formation of all roads, while the effects of the rising growth of the hedgerows, and the ultimate erection of buildings along it will be rendered less injurious. The highways or great lines of road should, in no instance, be formed of a less breadth than forty feet, and the metal bed not less than eighteen feet broad, with at least one footpath of five feet in breadth along the side; especially within a few miles of all towns and villages. It would be difficult to give any scale of breadths for public roads, the local circumstances of which vary so much. But, without presuming to be fastidious, we notice, that, within six or eight miles of all large cities or towns, the approaches should not be formed at less than sixty feet between the fences. In such situations the whole breadth should be metalled, or laid with broken stones. In the vicinity of towns of about 50,000 inhabitants, the breadth should be at least fifty feet between the fences, and be in like manner metalled from side to side. Where the population does not exceed 30,000, the statutory breadth of forty feet may be adopted, the metalling being still continued of the whole breadth, with paved side-drains. At intermediate distances, where it is not thought advisable to have the metal of a greater breadth than eighteen feet, the compartments between the metal bed and the side-drains may be laid with gravel or chips of stone to the depth of not less than half the thickness of the central part of the road. In the vicinity of London, and the capitals of Dublin and Edinburgh, and other great towns, as Glasgow, Manchester, Liverpool, &c. it would be desirable that the principal approaches were at least seventy feet in breadth, fully metalled between the side-drains, which ought to be neatly formed, and paved, and the roads provided with a foot-path on each side.

Fabric of the road.

By the fabric of the road is more particularly meant, the component parts of the metal bed. Where the bottom is naturally wet and spongy, it is well to *ram* it with chips of stone or with rubbish somewhat freed from earthy particles. It is extremely desirable, in every situation, that the road-metal should be broken to a uniform size, so as to form a compact body throughout. But, as the preparation of the small metal suitable for the surface of a road is expensive, it will, in many situations be found advisable to a lay a stratum or course of *hand-laid* stones, of from five to seven inches in depth, with their broadest ends placed downwards, and the whole built compactly together, upon the prepared bed or soil. On this course of stones, broken metal to the depth of not less than eight inches may be laid, though the quality of the rock should be kept in view in fixing the depth of this upper stratum. In fixing upon the size of the top metal, the more hard and tough its nature is, the smaller it may be broken; it being an object of main importance to have the metal "well assembled," as the road-makers express it, or broken of a uniform size. In almost every county there is a variation in the quality of the rock, and also in the size to which it is broken. Roads have latterly been made under a specification as to the weight of the pieces, varying from six to eight ounces. Formerly it was not uncommon to have them specified, of the size of a "hen's egg," or even of "a man's fist." By reference to weight, the road-maker's operations became more precise; but regard should also be had to the specific gravity of the materials, which differs considerably. For example, granite may be taken at twelve cubic feet in the ton, and whinstone (the greenstone, basalt, and clinkstone of mineralogists) is often met with of similar weight. Compact limestone and flint are about fourteen, and quartzy sandstone about fifteen feet to the ton. Perhaps the most convenient and uniform test for the size of road-metal is a ring measuring two inches and a half diameter in the void. When the metal is thus broken, and the road carefully treated, its surface soon becomes smooth and compact, without requiring the addition of blinding, or filling up the interstices with gravel, which, if used, should be free of earthy particles. But this addition is hardly necessary, where there is much traffic, as the rough and angular sides of the metal soon lock into each other, and form a smooth surface.

After opening a new road, a weighty roller may be passed over it with advantage; but attention should be paid to working the whole surface equally, and raking the displaced stones into the tracks, to prevent these from becoming deep ruts. For this purpose, wooden tresses are now generally set across the metalled part of the road; and, by shifting these, the carriages are made to pass alternately over the whole surface, and obliged to take up new tracks, until the whole becomes smooth and compact. Such treatment, in the first instance, effectually prevents it from getting into disorder; and to this simple operation we are very much indebted for the improved smoothness of our roads. With regard to the theory often advanced, by which the bottom or hand-laid stones are said to work their way from the bottom to the surface, and to be thus supplanted by the top metal; we cannot help thinking that much of this appears to be fancy; and that this has been generally owing to the more careless manner in which new roads were formerly constructed, and also to the little care which was afterwards paid to them. It is, in fact, quite notorious, that, till within a short period, there was, throughout the kingdom, a very general want of systematic attention, both in the making and upholding of public roads. The metal was neither uniformly broken nor judiciously applied; nor was the fair and regular working of the road duly attended to. Our new roads, consequently, got into ruts soon after they were opened to the public, by the displacement of the broken stones before they became bonded or connected with one another; and it generally happened, that the appearance of the bottom metal was the first intimation of the top-metal having been worn out, and the road in a state of total disrepair.

Gravel roads.

The chaussée, or paved road, is so universal on the continent, and the proper gravel road so common to the southern districts of England, that foreigners, from the smoothness of the British roads, give the general appellation of gravel roads, even to those that are made with small broken stones. The use of small gravel from the sea beach upon public roads, can hardly be considered suitable, as they seldom bind or form a compact road like broken metal which has a number of rough sides and angular points to connect it. Gravel answers very well upon the side compartments, between the metal-bed and lateral drains, and also for foot-paths; but should not be used for the central parts, unless it be laid nine or ten inches in depth, and of a size which will barely pass through a ring of about one inch in diameter. If it be of a larger size it should be reduced by the hammer, and then it makes a most excellent road. In mountainous districts, a peculiar description of road-metal is sometimes found, which is technically termed *mountain-gravel.* It occurs along with minute portions of earthy or clayey particles, which have the property of binding the whole together, and makes an excellent smooth road for light carriages.

Distribution of road-metal.

In the selection of road metal, we should always give a preference to the several varieties of greenstone. The best kinds of these are less friable than granite, when broken into small pieces. There is, however, no rule without exceptions, and it is often necessary, for want of better materials, to use sandstone, common limestone, and chalk, even in districts where there is a great deal of traffic; in some instances where coal is abundant, sandstone is reduced to a vitreous mass in kilns erected by the road side; but all such road metal is now used very sparingly in the formation of modern roads, and confined chiefly to the bridle-tracks. The distribution of road-metal may be considered as partial and irregular. Throughout Scotland, and even as far south as the approaching sources of the rivers Tees and Ribble, good road-metal is generally to be met with, containing the numerous varieties of granite, greenstone, basalt, porphyry, and limestone. South of this boundary, as far as the Trent and the Dee, in Cheshire, the formation is chiefly coal, sandstone, and the softer varieties of limestone. In the southern counties chalk and gravel soils chiefly occur, affording flint and gravel, both of which, under proper management, make excellent roads. In North and South Wales, we have all the varieties of road-metal which are common to Scotland. In Ireland they have excellent road materials, as granite and limestone are pretty generally distributed.

Notwithstanding the improved state of our roads, and that every pains is taken to obtain the best road-metal, yet it is impossible to preserve a smooth surface with broken metal, excepting at a great expence. It is quite astonishing in how short a period our best roads get into disrepair. Where there is much traffic, it requires constant unwearied attention to keep them in good order; and the waste of materials is almost incredible. Of this every one may satisfy himself, even from the quantity of clayey stuff which is occasionally raked off the roads in wet weather, or blown away in the state of dust in dry weather. Indeed, we hesitate not to express our fears that broken metal will be found unsuitable for the thoroughfares of great towns. We have observed where this has been tried, in some few instances, in England and South Wales, that the inhabitants complain of having "all the dust of summer, and all the dirt of winter."

From the difficulty and expence of keeping causewayed streets in a tolerably good state of repair, together with the jolting and jarring noise which attends them, the public has long been in quest of a smooth and durable city-road. Even cast-iron plates, in the form of causeway, have been tried. The small metal system is also in the act of being tried on several of the streets of London; but as yet experience does not enable us to say with what effect. In London, Dublin, Edinburgh, and other large towns, the streets are paved generally with granite or greenstone. This description of paving is properly of two kinds, the one termed ruble causeway, in which the stones receive a very partial chipping or hammer-dressing from the pavier. The other, termed aisler causeway, is more carefully dressed. The stones are also of a larger size, varying from five to seven inches in thickness, from eight to twelve inches in length, and about a foot in depth. The late introduction of this description of causeway, was considered at the time to be the perfection of this kind of road. But notwithstanding many precautions to the contrary, all dressed causeway stones are formed with the lower end, or that which is set on the ground, somewhat smaller than the upper surface. The consequence is, that they too often only touch at or near the top, and when a pressure comes upon one end of a stone so laid, it is apt to sink, while the other end is proportionally raised, and in this manner the causeway becomes dislocated, and gets into numerous hollows. This operation is still more rapid in the ruble causeway, which consists chiefly of small angular pieces of a variety of forms, which more easily give place to the pressure of a carriage-wheel than the boulder or rounded stones, of which the Romans made general use, and which are still applied to streets both in England and Ireland. These stones, having a broad seat or bed, are not easily misplaced, though they make a very rough, noisy, and unpleasant path.

Perhaps the finest specimens of the aisler causeway to be met with in the united kingdom, are those of the Commercial Road of London; Great Sackville Street, in Dublin, and Leith Walk of Edinburgh. The traffic upon the whole of these streets is great. The latter forms almost the only thoroughfare to the port of Edinburgh. It is regulated by a special Trust, and its toll is generally rented at about L.5000, per annum. The causeway of Leith Walk is nearly two miles in length, its breadth between the kirb-stones, which line off a spacious foot-path on each side, may be taken at the average breadth of fifty-seven feet. The stones of which it is paved are of a cubical form, of the largest dimensions of aisler causeway, laid upon a bed of sharp *sea-sand*, free of earthy particles, measuring twelve inches in depth. It is now fourteen or fifteen years since Leith Walk was converted, from a very bad common road, into a spacious causeway, and although its surface now exhibits many inequalities, yet it has continued during that comparatively long period, and may continue as long, without requiring any considerable repair. Now, if we compare this with the continual repair to which all metal roads, with a traffic similar to that of Leith Walk are incident, we presume that the metal would require to be renewed at least every third year. It must, therefore, have cost, upon the whole, a much greater expence than causeway, independently of the inconvenience which attends frequent operations of this kind upon such a thoroughfare; and its annoyance from dust, &c.

If, therefore, we can suggest a system of road making which shall secure to us all the advantages of a smooth and uniform railway, with the ultimate economy of the aisler causeway, we conceive that much shall have been gained, towards the facility of carriage, and the comfort of travelling. This we propose to effect by laying stone tracks, if not throughout the whole extent of certain principal roads, at least upon all their acclivities. These undulations oblige the carrier to modify his load, perhaps to one-half of what he could take upon a level road. If, in the same manner, the streets of towns and villages situate on the highway were laid in this manner, the traveller would pass smoothly along at his ease, instead of the thundering noise and jolting motion so irksome to himself, and dangerous and annoying to the respective inhabitants. Nothing is more common than the expression, "Now we have got off the stones we shall be safe and comfortable." The writer of this article remarks, in proof of this, that, in the course of his numerous journeys, he has been thrice in a carriage broke down, and upon two of these occasions he was passing along a city road.

We have already remarked that some of the Roman highways were formed with squared materials of large dimensions, as is still the case in Milan, and other cities of Italy. Several tracks of stone-rails of limited extent are to be met with in various parts of Britain; the stones of which these railways are composed, generally measure from three to four feet in length, from ten to twelve inches in breadth, and from eight to ten inches in depth. In the neighbourhood of Aberdeen there is a granite railway of this description, which runs several miles along, or in conjunction with, a common metalled road. But we observe that, unless stones of such lengths as three or four feet be deeply seated in the ground, and altogether contain as large a mass of rock as those of Italy, in proportion to the greater weight of English carriages, they will be too weak for their length, and it will hardly be possible to keep such rails firmly in their places, and in this way the chief benefit of a connected railway will be lost. Besides, large stones are always more difficult to be procured, transported, and laid in their places, than stones of smaller dimensions. An objection of no small importance also occurs in the use of these large materials, from the danger there is of horses slipping their feet and coming down upon the road. To avoid this, the practice in Italy is to keep the stones in a rough state, by occasionally cutting grooves upon the upper surface with a pick-axe, when they get into a smooth state with the carriage-wheels. This mode of paving with large blocks has in some instances been practised on a small scale in London, with granite; but in order to give stones of this kind the necessary stability, the blocks would require to be cubes, or to have their dimensions equally large on all their sides, which, upon the whole, would be attended with a great expence.

Plan by Mr. Matthews.

It appears from the reports of the committee of the House of Commons, on the improvement of roads and highways, that Mr. Henry Matthews, of Walworth Common, proposed a plan for stone-railways upon an extensive scale, for the principal highways of the kingdom. The stones which he was to employ, were to measure about four feet in length, ten inches in depth, eleven inches in breadth at the top, and fourteen inches at the base. At the points of contact the stones of some of these tracts were to be connected with a smaller block, by a kind of mortice-formed joint, similar to those represented in Figs. 5, 6, and 7, Plate CCCCLXXX. and described at the end of this article. The expence of Mr. Matthews' plan was probably one of its chief objections, having been estimated at L.1, 5s. per lineal yard for each set of tracks. It would probably also have been found in practice, that unless the cubic contents of these blocks had borne a greater proportion to their length, they would not have withstood the necessary pressure of carriages.

Plate CCCCLXXX. Figs. 5, 6, 7.

Plan by Mr. Stevenson.

In the several examples of this description of railway which we have met with, the stones have always been of considerable lengths. Now, it appears to us that, by introducing numerous joints, we shall not only secure the safety of the horses, and prevent the risk of their falling, without the trouble of cutting grooves in the stone, but that by keeping them of a length not exceeding that of the best aisler causeway, we shall, at a moderate expence, be able to procure materials proportionable in all their dimensions, and which can be easily kept in their places. This will be more readily understood when it is considered that a carriage-wheel impinges or rests only upon about an inch of its track at a time in the course of its revolution. There is, so to speak, a kind of compensating effect, connected with the use of small stones, which prevents the tremour from being communicated beyond the limited sphere of a few inches, instead of several feet.

In the *Transactions of the Highland Society of*

Scotland, vol. vi. this mode of making a smooth and durable road, by laying tracks with stones not much larger in their cubic contents than those of aisler causeway, is described as equally applicable to the streets of a city and the acclivities of the highway. Indeed, judging from the duration of causewayed streets, such is the comparative economy of this system, that we despair not of seeing it very generally used on our public roads. It appears to have been first proposed for the main-street of the town of Linlithgow, which forms part of the great western road through Falkirk to Stirlingshire, by Mr. Stevenson, engineer. Specimens of these tracks have been submitted to the inspection of Lord Melville and to some of the leading road-trustees of the county of Edinburgh, and to several of the commissioners for paving the streets of the parishes of London, where it is expected to be submitted to trial. This plan will be readily understood by examining Figs. 1 and 2, Plate CCCCLXXX. and its letter-press description at the end of this article, in which a street or highway, supposed to measure about thirty feet in breadth, is laid out in five compartments, independently of the footpaths. Two of these are paved with the aisler causeway tracks, laid five feet apart, while the intermediate spaces for the horse-paths may either be of ruble causeway, or broken stones in the usual way.

Plate CCCCLXXX. Figs. 1, 2.

Description of the tracks.

The tracks may be formed of granite, greenstone, or any of the hard varieties of rock which is capable of being dressed with a hammer, to dimensions not less than the following;—say, from six to eight inches in the length way of the track, twelve or fourteen inches in depth, eighteen inches in breadth at the base, and twelve inches at the top or wheel-track. The sides of the stones where they come in contact with each other, are to be dressed so as to form a plain close joint across the track, and the top is to be flat, that carriages may move without obstruction off and on the tracks, and, like the other sides, is to be dressed after the ordinary manner of aisler causeway. In laying these tracks, all that becomes necessary is to bestow some pains in preparing a firm and compact foundation, the nature of which will in a great measure depend upon the soil. A stratum of stone chips, of the depth of three or more inches, according to the state of the ground, laid in clean sharp sand, will answer in almost every case. It would, in some instances, be of advantage to lay the tracks with runners upon each side as kirb-stones, of about twelve or fourteen inches in length, especially in connexion with the common metalled road. But where ruble causeway is employed for the horse-paths, this precaution is unnecessary. In upholding roads of this description, the intermediate spaces will seldom require repair; and we have seen, in the example of Leith Walk, that aisler causeway has continued in good order for about fifteen years, and may last double that period with occasional repairs. Although the traffic of carriages would be greater upon the tracks than on a common road generally, yet it is a curious fact, that however spacious a road may be, carriages go very much in particular lines, one after another, and therefore the duration of an aisler causeway forms a very good criterion in judging of the comparative economy of the proposed wheel-tracks.

Smoothness and quietness of the road.

The smoothness of railway travelling has often been spoken of as luxurious, while the quietness with which vehicles glide along suit even the delicate ears of a Hollander, who, partly from this feeling, is induced to deprive the heavy loaded carriages and hackney coaches of their wheels, and form sledges, as is the practice in Amsterdam and other large towns of Holland. Till of late years, the thoroughfare into Somerset House, like the whole included area of that elegant suite of buildings, was paved with rough granite stones, and during the sittings of the Royal Society, and other public bodies, which held their meetings in the front row, the members were often disturbed by the noise of the carriages passing under the covered way into the square. This particularly attracted the notice of strangers, and the entrance alluded to has lately been laid with gravel, which, though not so cleanly as the tracks, is nevertheless a great improvement.

On the score of economy, we may notice that in the vicinity of Edinburgh, where good road materials of every description may be had at moderate rates, a lineal yard of these tracks, forming a road for one carriage, will cost from seven to nine shillings, according to the weight of the load to be conveyed upon them, and consequently double of these sums for two sets of tracks, to suit carriages travelling in opposite directions. These tracks may be estimated to last about twelve or fifteen years, in the ordinary traffic of a city or public road, in the course of which the metalling of a common road must have required to have been frequently renewed. Not only, therefore, will the comfort of the traveller be provided for, and the wear and tear of his carriage prevented, but the direct economy in upholding the public roads will, by the adoption of this system, be secured to an immense extent. An idea of this may be formed from the Reports of the Committee of the House of Commons, which goes the length of stating, that even Five Millions Sterling annually may be saved to the public by an improved system of roads.

Iron railways of the form hitherto in common use have of late been suggested both for travelling at speed and in the conveyance of all sorts of goods. Mr. Menteath of Closeburn, a considerable time since, made some progress in showing the application of iron wheel-tracks upon the numerous declivities which are every where met with upon the common road. This idea has also been acted upon by Mr. Baird of the Shotts Ironworks, which are situated on the side of a dell, in the bottom of which his foundery is built. In order to give greater facility in bringing up weighty articles from the works, Mr. Baird laid a very complete set of cast-iron tracks, applicable to the traffic of common carts, which admitted of the same load up-hill as in ordinary cases could be drawn upon a level road; a model of these tracks has been lodged in the chambers of the Highland Society of Scotland; they measure one foot in breadth, an inch and a half in thickness, and are fixed into the check of a cast-iron sleeper or bed, laid across the road in such a manner that they are neither apt to slip aside, to rise perpendicularly, nor to be sunk below their proper level; being nearly flat at the top, they admit of the wheels of a carriage getting off and on them at pleasure. The expence per lineal yard is understood to be about L.1, 5s. A rail-road of this kind was, in the year 1816, laid for the Forth and Clyde Canal Company, upon an acclivity leading to Port Dundas, near Glasgow, at the rate of one perpendicular to about 15 horizontal. In the presence of a committee of the Canal Company, one horse actually took up a load of three tons upon a common cart weighing nine cwt. without any apparent difficulty, till he reached the top of the railway, and was about to enter upon the common causeway. But, although the causeway was in good order, and the line of draught had become easy, the animal could proceed no farther than the extent of the cast-iron tracks. In any view of the application of these tracks to the partial acclivities of the common road, it is important to mention that the carters frequenting Port Dundas all agree in stating, that their horses had formerly as much difficulty in taking up 24 cwt. on the common causeway, as is now experienced with a load of three tons upon these wheel-tracks. Let us therefore consider the beneficial effects of such an immense acquisition of power, as the use of wheel-tracks would prove to carriage upon the great scale!

In an article treating distinctly of roads, we trust it will not be considered out of place if we notice two or three professional gentlemen who have more or less directed their attention to the road department of the engineer, and it is rather curious to notice that these happen to have belonged to Scotland. It was, we believe, the late Mr. Charles Abercromby who first adopted, as the leading principle of his designs, a more improved line of draught than the example either of the military or civil engineers of a more early period had afforded. But the appointment of Mr. Thomas Telford, as engineer to the Parliamentary Commissioners for roads and bridges, and the field thereby opened for his practice, may doubtless be mentioned as one of the most fortunate circumstances in the history of our improvement in this art. The highest praise is due to that eminent individual for the magnificence and extent of his various designs; and especially for the sedulous attention with which he has directed his great talents to all the details of Road-making. To these we gladly embrace the opportunity of adding the name of Mr. Loudon MacAdam, eminent as the founder of a system by which our public roads, formerly strong, though rough, are now becoming generally smooth, firm, and compact.

The country is perhaps not more indebted to the labours of the engineer than to the regular system of management which the road trustees have latterly adopted, both in respect to the conduct of their works and the management of their funds. Though Britain has not an organised professional board like that of France, for roads, bridges, harbours, and sea-lights, in one connected body, yet, in the affairs of roads, she may be said to possess a universal *Board of Freeholders* and their eldest sons, who, as trustees, manage those concerns with a patriotic feeling, a patrimonial interest, and a local knowledge, which has brought the British roads to their present state of pre-eminence. From time to time these gentlemen call professional men to their assistance, without sparing their own trouble, or withholding security, often to a great extent, upon their lands, for carrying on the operations of the trusts of which they respectively take the responsibility.

The management of roads is now so systematized as to have become, upon the whole, extremely simple. In Scotland, and now also pretty generally in England, the statute labour is commuted into a payment in money instead of personal service. With this fund, and the dues collected at the different toll-bars, the highways, parish and cross-roads, are made and maintained. The benefits of system, even in point of economy, is such, that some of the districts pay at the rate of L.700 or L.800 a-year, to the superintending engineer, for the management of about 150 miles of road. The more general way, however, in Scotland is, for the convener of the district to employ a thorough bred practical road-maker, who, as Inspector, receives a modified salary, attends to the state of the work, and directs the upholding of repairs. The road-metal, agreeably to this system, is quarried, carted, and broken by contract, at so much per cubic yard of broken stone. It is then, according to what we conceive to be the best arrangement, laid upon the road by day's wagemen. The money disbursements are made by the treasurer for the district, upon statements of the work done. In this manner the check on all hands is simple and direct, and there is not now the same opportunity for peculation and oppression that existed while the statute-labour was personally exacted.

In all improvements of any extent the trustees now proceed in a regular manner by plan, specification, and contract, instead of the more loose mode that was formerly practised. We have indeed been called to take a road off the hands of contractors, whose work amounted to several thousand pounds. The operations consisted in making the road partly new by certain alterations in the line of direction, while the remainder had undergone a thorough repair. In calling for documents it appeared that the line had never been professionally surveyed, that no section of the earth-work, or blasting of rock, had ever been made, nor had any regular contract been entered into. The works were inspected by the factor on a neighbouring estate, and afterwards travelled upon for twelve or fifteen months, without any precaution in filling up the ruts. This procedure arose from a misconceived and ill-applied economy; which has too often led business of this kind to be settled in a court of law, as in the instance alluded to.

Description of Plate CCCCLXXX.

Description of PLATE CCCCLXXX. Fig. 1.

Fig. 1. represents the plan of a street or road laid with two sets of stone-tracks formed of what may be called aisler, or the best description of causeway, of a form peculiarly simple, of dimensions easily procured, and calculated for supporting any load. Between, and on each side of the tracks of this diagram, the compartments are formed of common road-metal. The track-stones may be of granite, greenstone, or any of the harder kinds of rock that will admit of being *hammer-dressed.* To be properly bedded or laid upon a stratum of clean sharp sand, gravel, or stone chips, according to the state of the ground, and the situation of the country for procuring materials. At Bath, Paris, and other places, we have seen causeways carefully built with lime-mortar.

Referring to Mr. Stevenson's plan.

A B C D point out a compartment of a road laid partly with broken stones, in which E E and F F are the aisler-causeway tracks, A B being the sky or open drain upon the side of the road, which, if situated within, or near a populous town, is supposed to be

PLATE CCCCLXXX. Fig. 1.

paved. In the same manner, G H I K show the limits of a road also laid with tracks of aisler causeway, as marked at L L and M M, but here the compartments between and on each side are paved with ruble or inferior causeway stones.

Fig. 2.

Fig. 2. is a section of the plan described under Fig. 1, and shows the particular form of the aisler causeway-tracks, and other parts of the road, *a* is a paved drain, *b* one of the sides made with broken stones, *c c* two of the aisler causeway-tracks, and *d* the horse-path between them. In the same manner, *e f f* and *g* show the street laid with ruble causeway-stones on each side and between the tracks.

Fig. 3.

Fig. 3. includes a cross and longitudinal section of one of the track-stones, and from its simple form it will be seen that they may be prepared at the least possible expence, requiring only that the sides which come in contact should be squared, and made to form a joint touching throughout from the bottom to the top, the other sides being dressed as common aisler causeway. The diagram *a b* represents a section of one of these stones taken across, or at regular angles, to the direction of the track. It measures eighteen inches in breadth at the base, twelve inches at the upper surface, and fourteen inches in depth. *c d* is another section of the same stone, taken in the longitudinal direction of the track, which is here supposed to be eight inches in thickness, though in this dimension it may be varied to any range from six to nine inches to suit the quarry.

Fig. 4. Section of common road.

Fig. 4. is a semi-cross section of a common road. The letters A B C showing the metal or broken stones in strata of a uniform thickness in the central parts as between A B, but diminishing towards the side-drain at C. The chief thing to be observed, is the form given to the bottom, which takes the same curve as the upper surface of the road. By this means the drainage is assisted, and the road metal is saved, as there is not a greater depth of broken stones under the horse-track where it is less required than under the carriage-wheels.

Figs. 5, 6, 7, refer to Mr. Matthews' plan.

Figs. 5, 6, and 7, represent a plan of stone-railways suggested by Mr. Matthews of Walworth, to the committee of the House of Commons on highways. He proposes that the stones should be in pieces, measuring four feet two inches in length, eleven inches in breadth at the top, fourteen inches at the base, and ten inches in depth. The diagrams to which the figures refer, show three sets of tracks with various modes of forming the connecting joints. Fig. 5. is a kind of *mortice and tenon* joint, marked *a b* and *a b*, in which the stones are inserted into each other near the top, in a bevelled fashion, with a view to prevent the joint from sinking. Fig. 6. forms a plain bevelled joint, in which the ends of the two rails are made to rest upon a centre or intervening block of stone, as at *c d* and *c d*. In Fig. 7, the letters *f g* and *f g* show the same description of joint, and its bearing, but with a joint somewhat more complicated in its outline or form.

Authors to be consulted. Bergier's *Histoire des Grandes Chemins de l'Empire.* Philips' *Dissertation concerning the High Roads.* Homer's *Enquiry into the State of Roads.* Lambert *on the best Ascent of Roads.* Edgeworth *on Roads and Carriages.* Young's *Natural Philosophy.* Wilkes *on Concave Roads.* Wright *on Watering Roads.* Ellis *on Washing Roads.* Cumming *on Broad Wheels,* &c. Booth *on Wheel Carriages.* Erskine *on Iron-roads. General Rules for Road-making,* published by Taylor, London. Paterson's *Practical Treatise.* M'Adam's *Remarks on the Present System of Road-Making. Communications to the Board of Agriculture. Parliamentary Reports.*

ROADS, MARINE. A Road for ships is not easily defined, but in a nautical sense it may be considered as differing from a haven or harbour, in respect that it is generally more spacious and easy of access, though perhaps a less safe or protected anchorage than a proper harbour, and with a greater depth of water, say from seven to fifteen fathoms.

The marine roads which are chiefly frequented on the eastern coast of Great Britain, are those of Lerwick Bay in Shetland, Long-Hope Bay in Orkney, Cromarty Frith, Leith Roads, the entrance to the Humber, Yarmouth Roads, and the Downs. But those most accessible, in connection with the North Sea, are the Friths of Leith and Cromarty. On the coast of Holland, the Texel and Helvoet may be noticed, and on the French side of the British Channel, Cherbourg, formed by a breakwater three miles in extent, with a depth of from seven to nine fathoms in the interior. On the British side we have Portsmouth, St. Helens, and the protection of the Isle of Wight generally; Plymouth Sound, now greatly extended as an anchorage by the breakwater; and lastly, upon this range of coast, Falmouth. In St. George's Channel we may be said to be limited to Milford Haven, though Holyhead and Dublin are in progress of becoming places for the general rendezvous of shipping. The Clyde and the Highlands of Scotland afford many safe natural roads and anchorages; while Ireland presents Cork, the Shannon, Loch Swilly, Belfast, and others.

These are all places of resort for the larger classes of ships, and may be termed public roads, as no harbour-dues are exigible. There are very few good harbours upon the eastern and southern sides of the British coast, that ships of a considerable burden can safely run for in bad weather, or in all states of the tide. Improvements of this kind are much wanted on the coasts of Aberdeen, East Lothian, and Fife, in connection with the friths of Forth and Moray. On the Yorkshire, Norfolk, and Suffolk coasts, and particularly on the Kentish coast, in connection with the Downs, good harbours are in great request. It would likewise be of national importance if Weymouth or Portland-road were converted into a safe anchorage.

It here deserves our particular notice, that a great change has been brought about in the more general means for the anchorage of ships, by the introduction of chain moorings for common use. By means of this strong and flexible cable, ships can now ride on a much greater range of coast, with off-shore winds. Formerly, the utmost precaution was necessary in the selection of a road-stead, in laying down a hempen cable, so as to avoid a hard or rocky bottom. Now this is happily become a matter of less importance, as the chain cable is proof against slight injuries. We have, therefore, no hesitation in saying, that the mariner and the country at large are under the greatest obligation to the ingenuity, professional skill, and perseverance of Captain Samuel Brown of the royal navy, for the general introduction and application of this invaluable discovery for our navy and mercantile marine.

ROANNE, a town of France, of considerable magnitude, situated on the left bank of the Loire. The streets are very long, and in general narrow and dark. Many of the houses are good, though of a gloomy aspect. The only public buildings are the churches, which are four in number; the Maierie, which was formerly the church of the Capuchins; and the prison, which is behind the market place, and near the principal church. In 1814, when we visited this town, the bridge over the river was of wood, and was connected with the right bank of the river by an earthen embankment. A noble stone bridge, however, across the Loire, was then begun, and promised when completed to be one of the finest in France. Five arches were at that time completed, and the piers of other two were laid on the south side of the river, and yet these seven arches did not reach nearly to the southern extremity of the present wooden bridge. Twelve at least seemed to be necessary to cross the river.

This town was only a village in the beginning of the eighteenth century, and has risen to its present importance by being the entrepot for goods sent from the east and south-east of France, to Paris, Orleans, Nantes, and other towns. The manufactures of Roanne consist of linen and cotton goods, and small articles of hardware. Population, 8000. East long. 4° 4′. North lat. 46° 2′

ROBERTSON, William, D.D. a celebrated historian, was the son of the Rev. Mr. Robertson, and was born at the manse of Borthwick, in Mid-Lothian, in the year 1721. He received the elements of a classical education at the school of Dalkeith, under Mr. Leslie; and in the year 1733, when his father was removed to the Greyfriars church in Edinburgh, he entered his son at the University, where he exhibited that ardour in the prosecution of his studies, and the germ of those talents by which he was afterwards so highly distinguished. He initiated himself early into the practice of literary composition, and with the view of improving his style, he made frequent translations from foreign authors, and had prepared for the press a translation of Marcus Antoninus, which he was prevented from publishing, by the appearance of a similar work at Glasgow.

When he had completed his course at the university, he was licensed as a preacher of the gospel, in 1741, and in 1743 he was presented by John Earl of Hopetoun to the living of Gladsmuir, in East-Lothian. Having about this time lost his father and mother, his appointment to a living was a most fortunate event, as the charge of six sisters and a younger brother had thus devolved upon him. When Edinburgh was in danger of being taken in the year 1745, Mr. Robertson felt himself justified by the critical state of public affairs, to quit his manse at Gladsmuir and join the volunteers in Edinburgh. Upon the surrender of the city, he went to Haddington, and offered his services to the commander of the king's forces.

On the restoration of tranquillity in Scotland, he returned to the duties of his parish, and in the year 1751 he married his cousin Miss Nesbit, whose father was one of the ministers of Edinburgh. Amid the settled habits of domestic life, our author now devoted himself diligently to his studies, and to the duties of his office, which he discharged to the great satisfaction of his parish. His reputation as a preacher had now become great, and from this circumstance he was invited to preach before the Society for promoting Christian Knowledge. This sermon, which has been greatly admired, was published in 1755. It went through five editions, and was translated into German.

Robertson, D.D.

In the proceedings of the general assembly of our church, Mr. Robertson had already taken an active part; but in 1757, he distinguished himself by his defence of Mr. John Home, minister of Athelstaneford, in the same presbytery with himself, who had written the tragedy of Douglas. (See Home, John.)

The lead which our author now began to take in the management of the church courts with which he was connected, though by no means favourable to the peaceful habits of literature, does not seem to have interfered with his studies. Soon after his settlement at Gladsmuir, Mr. Robertson had formed the plan of a History of Scotland, and as it was now nearly ready for press, he went to London for the purpose of arranging with a bookseller, respecting its publication. It was published in 1759, in two vols. 4to. under the title of *the History of Scotland during the reigns of Queen Mary, and King James VI. till his accession to the crown of England; with a review of the Scottish history, previous to that period: and an appendix of original papers;* to which is added, *a critical dissertation concerning the murder of King Henry, and the genuineness of the Queen's letters to Bothwell.*

The success of this work was great beyond all example. In the course of a year it had passed through three editions, and it underwent no fewer than fourteen editions in its author's life. The beauty of the style, and the judgment and discrimination of the author, attracted universal attention, and drew forth the praise of most of the distinguished men of the day.

In the year 1758, Dr. Robertson removed with his family to Edinburgh, in consequence of receiving a presentation to one of the churches in that city. In 1759, he was appointed chaplain to the garrison of Stirling castle. In 1761, he was made one of his majesty's chaplains in ordinary for Scotland. In 1762, he was chosen Principal of the University of Edinburgh; and, in 1764, the office of historiographer to his majesty for Scotland was revived for his benefit, with a salary of £200 per annum. These rapid promotions, so well merited, and so judiciously conferred, served to excite our author to still higher efforts. The choice of a subject had perplexed him exceedingly, and, among many which had been suggested, that of a history of England was particularly recommended to his attention. His majesty, George III. did him the honour to express a wish to see a history of England from his pen, and the Earl of Bute promised him all the aid that could be desired from the records in the possession of government. Dr. Robertson was at first disposed to consider such a work as interfering with Mr. Hume's, with whom he lived in habits of the greatest friendship; but when the offer of the king's patronage, and the aid of the minister were tendered, he seems to have seriously thought of the undertaking. "The case," he says, in a letter written at the time, "is entirely changed. His (Mr. Hume's) history will have been published several years before any work of mine on the same subject can appear; its first run will not be marred by any jostling with me, and it will have taken that station in the literary system which belongs to it. This objection, therefore, which I thought, and still think, so weighty at that time, makes no impression on me at present, and I can now justify my undertaking the English history to myself, to the world, and to him. Besides, our manner of viewing the same subject is so different, or peculiar, that (as was the case in our last books) both may maintain their own rank, have their own partizans, and possess their own merit, without hurting each other."

Although our author seemed from this letter to have made up his mind to compose a history of England, yet he afterwards abandoned the idea, and we cannot doubt that this was done principally out of regard to the feelings of Mr. Hume; who, notwithstanding the arguments urged in the preceding extract, could not but feel that it was an inroad upon the territory which he had so successfully cultivated, and over which courtesy had assigned to him a literary supremacy.

Dr. Robertson therefore proceeded in completing his *History of the Reign of Charles V.* for which he had collected materials, and which was published in 1769, in three volumes quarto. In order to render intelligible this portion of the history of Europe, he devoted a preliminary volume to an account of the "*Progress of Society in Europe, from the subversion and downfall of the Roman Empire to the beginning of the sixteenth century.*" This volume, which may be considered as an introduction to the History of Modern Europe, required a degree of study and of patient research, which few men were capable of devoting to it; and on that account, as Mr. Stewart remarks, "it is invaluable to the historical student, and suggests in every page matter of speculation to the politician and to the philosopher."

In composing the history of Charles V.'s reign, Dr. Robertson was naturally led to complete the narrative of the events connected with it, by giving an account of the affairs of Spain in the New World. As the interest of such a work, however, would naturally be much limited, he resolved to extend it so as to embrace the transactions of all the other nations of Europe in the New World; and he had also determined to compose a volume on the history of the British empire in America. The last part of this plan he never attempted to execute, owing principally to the civil war which then raged between America and the mother country, but the first part appeared in 1777, in two vols. 4to, entitled *The History of America*, a work which was well received by the public, and added greatly to the reputation of our author. It has been said, we think not with much truth, that he has shown a disposition to palliate the cruelties of the Spaniards, but this seems to have been inferred, less from the expression of his own sentiments, than from the compliment paid to him by the Royal Academy of Madrid, who elected him, in 1777, a member of the Royal Academy of History in that metropolis. The Academy, at the same time, appointed one of its members to translate the work into Spanish, and a considerable progress was made in the translation, but the Spanish government interposed its authority to stop the publication of the work. In the Preface to the *History of America*, Dr. Robertson mentioned his intention of resuming the subject; but he does not seem to have advanced far in the undertaking. A fragment of the work, however, has been published since his death, entitled, *Two additional Chapters of the History of America.*

Having abandoned the plan of writing a history of our own empire in America, Dr. Robertson looked out for some other subject worthy of his pen. Mr. Gibbon recommended to him a history of the Protestants in France, but several of his friends suggested the history of Great Britain, from the Revolution to the accession of the House of Hanover, and it would appear from a letter to Dr. Waddilove, Dean of Rippon, dated July 1778, that he had made up his mind to encounter the responsibilities of such a task. It appears from a letter of Gibbon's, that Dr. Robertson had abandoned this plan before the end of the year 1779; and Mr. Stewart remarks, that "whatever the motives were which induced him to relinquish it, it is certain that it did not long occupy his thoughts."

This passage of Mr. Stewart's memoir evidently shows that he was not in possession of the correspondence between Dr. Robertson and Mr. Macpherson, which took place respecting this projected work, and it seems quite certain that Dr. Robertson abandoned the project out of respect to the feelings of his friend Mr. Macpherson, who had published in 1775 a history of the same reigns, with the most interesting collection of original papers that had ever been given to the world. It appears, indeed, from these unpublished letters, which are now before the writer of this article, that it was more than probable that Dr. Robertson would never have completed the work, even if the feelings of a friend had not stood in the way of its accomplishment.* Dr. Robertson was now approaching the age of sixty, a time when laborious study ceases to be agreeable. He was independent in his circumstances, and his reputation was as high, and his fame as widely extended, as he could possibly have desired. Under these circumstances, his love of easy and amusing occupations had probably no inconsiderable share in making him abandon the project of his English History.

Notwithstanding our author's resolution to write no more for the public, he was accidentally led on to the composition of another work. In perusing Major Rennel's *Memoir of a Map of Hindostan*, he began to inquire into the knowledge which the ancients had of that country, solely for his own amusement and instruction. His ideas, as he himself remarks, gradually extended, and became more interesting, till he at length imagined that the result of his researches might prove amusing and instructive to others. In this way he was led to publish his *Historical Disquisition concerning the knowledge which the Ancients had of India*, and *the Progress of Trade with that Country prior to the Discovery of the Cape of Good Hope*, which appeared in 1791 in 4to.

This was the last work which Dr. Robertson published. No sooner had he finished it than his health began visibly to decline. Strong symptoms of jaundice showed themselves, and laid the foundation of a lingering and fatal illness. In order to enjoy a better air, and the relaxations of the country, he removed to Grange-house in the neighbourhood of Edinburgh, where he was able to walk abroad, and generally spent a portion of the day in a small garden attached to the house. In June 1793, his disease confined him to his couch, and he died on the 11th of June 1793, in the seventy-first year of his age.

It would be a waste of time to attempt to give any detailed sketch of Dr. Robertson's literary character. His works have been translated into all the languages of Europe; and his talents as a historian have everywhere been reckoned superior to those of any rival author. "The general strain of his composition," says Mr. Stewart, is flowery, equal, and majestic, harmonious beyond that of most English writers, yet seldom deviating in quest of harmony into inversion, redundancy, or affectation." "It may, perhaps, be questioned by some, whether Dr. Robertson has not carried to an extreme his idea of what he has himself called the dignity of history; but whatever opinion we form on this point, it cannot be disputed that his plan of separating the materials of historical composition from those which fall under the provinces of the antiquary and of the writer of memoirs, was on the whole happily conceived; and that one great charm of his works arises from the taste and judgment with which he has carried it into execution. Whenever his subject admits of being enriched or adorned by political or philosophical disquisitions, by picturesque description, or by the interesting details of a romantic episode, he scruples not to try his strength with those who have excelled the most in those different departments of literature."

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* This very interesting correspondence will be soon published in an *Account of the Life, Writings, and Correspondence of James Macpherson, Esq.*

In estimating the relative merits of Dr. Robertson's different works, Mr. Stewart is of opinion that his *Charles V.* is that which unites the various requisites of good writing in the greatest degree. The style he considers as more natural and flowing than that of the *History of Scotland.* The style of his *History of America* he regards as less uniformly polished than that of his other works, and as less simple and concise, though it contains many passages equal, if not superior, to any thing else in his writings.

Dr. Robertson continued to superintend the affairs of our national church, as the leader of the General Assembly, (to which he was returned as a member every year by the University,) till the year 1781, when he withdrew from the bustle of active life. In the most essential qualifications of a speaker, Mr. Stewart is of opinion, that he was entitled to rank with the first names which have in our times adorned the British senate. "His eloquence," he remarks, "was mild, rational, and conciliating, yet manly and dignified."

In his pastoral character Dr. Robertson was exemplary in the discharge of his duties, and his diligence in this respect increased as he advanced in years. He had unfortunately lost, before he left Gladsmuir, a volume of sermons, which he had composed with care, otherwise we might have been gratified with more specimens than we possess of his pulpit eloquence; but his colleague, Dr. Erskine, informs us, "that his discourses were so plain that the most illiterate might easily understand them, and yet so correct and elegant, that they could not incur their censure whose taste was more refined."

In his private character, Dr. Robertson displayed all the virtues of domestic and social life. He had the satisfaction of leaving his family in prosperous circumstances; and his eldest son, the present Lord Robertson, has raised himself, by his talents and character, to one of the highest dignities of his profession.

In stature Dr. Robertson was rather above the middle size, and his form was vigorous and robust. There is a picture of him by Sir Joshua Reynolds, from which a good mezzotinto has been engraved; and there is another taken at a later period, at the request of his colleagues, and placed in the library of the university.

In the year 1781, Dr. Robertson was elected one of the foreign members of the Academy of Sciences at Padua, and, in 1783, one of the foreign members of the Imperial Academy of Sciences at St. Petersburg. The Empress Catharine was so much delighted with his works, that she presented him, through the late Dr. Rogerson, with a handsome gold enamelled snuff-box, richly set with diamonds.

Robespierre,
Robins.

Dr. Robertson was the founder of the Royal Society of Edinburgh, and exerted himself with his usual zeal, not only in forming the plan of that institution, but in carrying it on after it was established.

Those who wish for farther information respecting the life and writings of this eminent author, are referred to Mr. Dugald Stewart's *Account of the Life and Writings of Dr. Robertson*, Lond. 1801.

ROBESPIERRE. See FRANCE, Vol. IX. p. 635.

ROBINS, BENJAMIN, a celebrated English mathematician, was born at Bath in the year 1707. Although his parents, who were Quakers, were not able to give him much education, yet, from the native vigour of his own mind, he initiated himself into various branches of knowledge, particularly mathematics. His friends being desirous that he should be brought into notice, wished him to settle in London as a teacher of mathematics, and contrived to get him introduced to Dr. Pemberton, who conceived a high opinion of his mathematical acquirements.

Robins accordingly went to London, and began to fit himself for the duties of a teacher, by perusing the writings of the most celebrated mathematicians. In the course of these studies, he was led to demonstrate the last proposition of Sir Isaac Newton's *Treatise on Quadratures*, which appeared in the *Philosophical Transactions for* 1727. In the following year he published "The Present state of the Republic of Letters, in Refutation of the Dissertation of John Bernouilli on the Laws of Impact in Moving Bodies," which had lost the prize offered by the Academy of Sciences in 1726.

Having thus brought himself into notice as an able mathematician, Robins laid aside the dress of a Quaker, and began to take mathematical pupils. The activity of his mind, however, did not allow him to be satisfied with his theoretical studies. He began a series of elaborate experiments in gunnery, with the view of establishing the great influence of the resistance of the air upon projectiles. He also directed his attention to the various branches of civil engineering; and he made several tours to Flanders, for the purpose of studying the subject of fortification.

Upon his return from one of these journies into Flanders, in 1734, he found the scientific world thrown into a state of alarm by the appearance of Dr. Berkeley's *Analyst*, in which that ingenious author attempted to refute the Newtonian doctrine of fluxions. Robins was requested to devote himself to its defence, and he accordingly published, in 1735, "A Discourse concerning the Nature and the Certainty of Sir Isaac Newton's Method of Fluxions, and of Prime and Ultimate Ratios." Some exception was taken at this defence, even by some of the friends of the fluxionary method, which led our author to publish two or three additional discourses on the subject.

In the year 1738 Robins defended Newton against an objection in Baxter's *Matho;* and in 1739 he published his remarks on Euler's *Treatise on Motion;* on Smith's *System of Optics;* and on Jurin's *Essay upon Distinct and Indistinct Vision*, published at the end of the last of these works.

Robins did not confine his talent to their proper sphere of mathematics and natural philosophy. He took a keen part in the politics of the day, and composed three pamphlets on the affairs of the times. The

Robins. first was "*Observations on the present Convention with Spain;*" the second, a "*Narrative of what passed in the Common Hall, and the Citizens of London assembled for the Election of a Lord Mayor:*" and the third was an "*Address to the Electors and other free Subjects of Great Britain, occasioned by the late succession; in which is contained a particular Account of all our Negotiations with Spain, and their treatment of us for above ten years past.*" The first and third of these pamphlets which were anonymous, were so much thought of that they were deemed to be the productions of Mr. Pulteney, who was then the great opponent of Sir Robert Walpole. When Sir Robert was defeated by the opposition, Robins was chosen secretary to the Committee of the House of Commons that was appointed to examine into the conduct of the minister.

In 1742 Robins published his "*New Principles of Gunnery,*"* containing the result of his experiments on the force of gun-powder; on the resistance of the air in swift and slow motions; with an introductory history of modern fortification; of the invention of gun-powder, and of the theory of gunnery.

In consequence of a paper having been published in the *Philosophical Transactions* against some opinions of our author, he was led to submit to that learned body several dissertations on the resistance of the air, and to exhibit the experiments on which they were founded, in the year 1746 and 1747, for which he was presented with the gold medal of Sir Godfrey Copley. When Lord Anson returned from his voyage round the world, the Reverend Richard Walter, the chaplain of the Centurion, had proceeded a considerable length in drawing up an account of it. It was, however, deemed advisable to have the whole of it re-written by Robins. It accordingly appeared in 1748, but what was very unaccountable, the name of Mr. Walter was put in the title page. This work underwent several editions, and the 5th was corrected by Robins himself in 1749.

The next work of Robins was an apology for the unfortunate battle of Prestonpans, in Scotland. This apology formed a preface to "*the Report of the proceedings and opinion of the Board of General Officers, on the examination into the conduct of Lieutenant-General Sir John Cope,*" which appeared in London in 1749.

Mr. Robins, through the influence of Lord Anson, had opportunities of which he availed himself, of making farther experiments on his favourite subject of gunnery; and by the same influence he procured for the Royal Observatory of Greenwich a second mural quadrant and other instruments.

The services of our author had now become so numerous, and his reputation was so high, that the government was desirous of appointing him to some lucrative situation. It was accordingly put in his choice either to go to Paris as one of the commissioners for adjusting the limits of Acadia, or to be Engineer general to the East India Company, the ruinous condition of whose forts required an able engineer to put them in a state of defence.

He accepted of the last of these situations, and set out for India at Christmas 1749, provided with a complete set of astronomical and other instruments for making scientific observations and experiments in the East. After a hazardous voyage he arrived on the 13th July 1750, and he immediately prepared complete plans for fort St. David and Madras. His constitution, however, was not fitted for the climate. He had an attack of fever in September, and though he recovered from its immediate effects, yet he afterwards fell into a languishing condition which continued till his death on the 29th July 1751. By his will he left the publication of his Mathematical works to Martin Folkes, Esq. and Dr. James Wilson. From the ill health of Mr. Folkes, this duty devolved upon Dr. Wilson, who published the Mathematical and Philosophical works of his friend, in two vols. 8vo. in 1761, and prefixed to these an interesting memoir of his life.

Robins's "New Principles of Gunnery" was translated into several foreign languages. They were translated into German by the illustrious Euler, and accompanied with a copious commentary. This work was after translated into English in 1719 by Mr. Hugh Brown, with notes, in one volume 4to. Besides the works already mentioned, Mr. Robins wrote a paper on the height to which rockets will ascend, which is published in the *Philosophical Transactions* for 1749, p. 131. See our articles Gunnery and Pyrotechny, for an account of his principal labours.

ROBISON, John, a celebrated Scottish natural philosopher, was born at Boghall, in the county of Stirling, and parish of Baldernock. His father, Mr. John Robison, had acquired considerable wealth as a merchant in Glasgow, and had retired from business to his estate of Boghall, before the birth of his son. Mr. Robison received the rudiments of his education at the grammar school of Glasgow, and after going through the usual routine of classical instruction, he entered the University of Glasgow as a Student of Humanity in November 1750. Here he enjoyed the rare advantage of studying Greek under the celebrated Dr. Moore, who possessed an extensive knowledge of the ancient geometry; of acquiring mathematical knowledge under Dr. Robert Simson; and of studying the operations of the human mind in the lectures of the illustrious Adam Smith. Notwithstanding these advantages, Dr. Robison does not seem to have been a very hard student, and in after-life accused himself of want of application at the University. His fellow students, however, entertained the highest respect for his acquirements, and he had early excited notice by the ingenuity of his reasonings, and the boldness of his opinions. The instructions, however, even of Dr. Simson, do not appear to have inspired him with very ardent love of the mathematics, and he was led to attend to them only after he had discovered their use in natural philosophy. In the year 1756, Mr. Robison took his degree of M. A.; and in 1757, when the death of Dr. Dick, who was joint Professor of Natural Philosophy with his father, Mr. Robison is said to have been recommended by Dr. Adam Smith as a temporary assistant to the old gentleman. Mr. Dick, however, considered him as too young for such a situation, and he was therefore compelled to look out for some other employment.

His father, who was a man of exemplary piety, had destined his son for the church; but motives, with which we are not acquainted, but which certainly did not arise from any dislike to the objects or duties of the clerical profession, prevented him from yielding to the wishes of his family.

Dr. Blair, Prebendary of Westminster, happened at that time to be in search of a person qualified to go to sea with Edward, Duke of York, and to assist his Royal Highness in the study of mathematics and navigation. With the view of obtaining that appointment, Dr. Robison went to London with recommendations from Professor Dick and Dr. Simson; but he had no sooner arrived in 1758, than he learned that the projected voyage was not determined upon; and after waiting for some time in anxious expectation, he was mortified to find that the scheme was entirely abandoned. Having been introduced to Admiral Knowles, whose son was to have accompanied the Duke of York, the Admiral engaged him to accompany his own son to sea, and to take charge of his education.

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* An account of this work, by Robins himself, is given in the *Philosophical Magazine*, 1742-3, p. 437.

Young Knowles went out in 1759 as a midshipman on board of Admiral Saunders's ship, the Neptune of 90 guns, accompanied by Mr. Robison, but being promoted in the course of the voyage to the rank of lieutenant, on board the Royal William of 80 guns, Mr. Robison attended him on board that ship, and was rated as a midshipman.

This fleet, the object of which was to assist in reducing Quebec, reached the American coast in April, and in May it ascended the river St. Laurence. In this situation Mr. Robison had an opportunity of seeing a great deal of active service, and he was occasionally employed in making surveys of the river and the adjacent grounds.

"An anecdote which Mr. Robison used to tell," says Mr. Playfair, "deserves well to be mentioned. He happened to be on duty in the boat in which General Wolfe went to visit some of their posts the night before the battle, which was expected to be decisive of the fate of the campaign. The evening was fine, and the scene, considering the work they were engaged in, and the morning to which they were looking forward, sufficiently impressive. As they rowed along, the General, with much feeling, repeated nearly the whole of Grey's Elegy, (which had appeared not long before, and was yet but little known,) to an officer who sat with him in the stern of the boat, adding, as he concluded, that he would prefer being the author of that poem to the glory of beating the French to-morrow." To-morrow came, and the life of that illustrious soldier was terminated amid the tears of his friends and the shouts of his victorious army. The body of General Wolfe was brought to England in the Royal William, and was landed at Spithead on the 18th of November.

Mr. Robison had suffered severely from the sea-scurvy, which prevailed to an extraordinary degree on board the Royal William. Out of 750 seamen, 286 were confined to their hammocks, and 140 scarcely able to walk on deck. From that circumstance, and many others, his dislike of the sea became very great, and he resolved to return to Glasgow to prosecute his theological studies, with the view of entering the church. This resolution, however, was not carried into effect. Mr. Robison received from Admiral Knowles a kind invitation to live with him in the country, and assist him in his experiments on ship-building and seamanship.

Mr. Robison did not scruple to accept an invitation so congenial to his own studies; and in February 1762, when Lieutenant Knowles was appointed to the Vengeance of 20 guns, he accompanied his pupil, and was extremely desirous of being appointed Purser to the ship. After visiting Lisbon, and other parts of Portugal and Spain, he returned to England in June, and quitted the naval service. Before the end of the same year, Admiral Knowles, with whom he still resided, recommended him to Lord Anson, then the First Lord of the Admiralty, as a proper person to take charge of Harrison's Time-keeper, which, at the desire of the Board of Longitude, was about to be sent to the West Indies on a trial voyage. This eminent artist had completed his chronometer, "after having struggled," as Mr. Playfair remarks, "for 35 years against the physical difficulties of his undertaking, and the still more discouraging obstacles which the prejudice, the envy, and the indifference of his cotemporaries, seldom fail to plant in the way of an inventor." Mr. Robertson, of the naval school of Portsmouth, determined its rate and error on the 6th of November, and on the 26th of January Mr. Robison found it to indicate a difference of longitude of $5^h\ 2'\ 47''$, which is only four seconds less than it was found to be by other methods. Mr. Robison and Mr. Harrison embarked a few days afterwards on board the Merlin, which was sent to England with dispatches for Government. After a voyage marked by almost every species of naval distress short of actual shipwreck, the ship took fire, and it was with great difficulty that they reached Portsmouth on the 26th of March. On the 2d of April, the time of noon was found to be $11^h\ 58'\ 6''\frac{1}{2}$, instead of 12^h, so that the whole error from the 6th of November till the 2d of April, was only $1'\ 53\frac{1}{2}''$, which corresponds to about 20 miles of longitude.

Upon his return to England, Mr. Robison found Lord Anson afflicted with the illness of which he died, and his friend and patron Admiral Knowles disgusted with the admiralty and the ministry. His hopes of promotion depended only on his own personal services, and these were readily set aside at a period when England derived no lustre from the virtues of her statesmen.

Under these circumstances, Mr. Robison resolved to return to Glasgow, with the view of qualifying himself for the church, and upon his arrival there, he devoted his whole attention to the study of the sciences. The example of his friend Dr. Black, who was about to give to the world his great discovery of latent heat, and of Mr. Watt, who was then bringing the steam-engine to perfection, stimulated him in his scientific career, and his constant intercourse with these great men, fostered that love of experimental and practical science which directed him in all his future researches.

In the year 1766, when Dr. Black was removed to the chemical chair in Edinburgh, he recommended Mr. Robison as his successor. He was accordingly elected for one year, and commenced his first course of lectures in October 1766. In this situation Mr. Robison continued four years, but a new object now presented itself to his ambition. At the request of the Empress of Russia, Admiral Sir Charles Knowles was recommended to go to St. Petersburgh, for the purpose of reforming and improving the Russian navy. He engaged Mr. Robison to accompany him as his private secretary, with a salary of £250 per annum; and they set sail from England in December 1770.

In 1772, Mr. Robison was appointed Inspector-General of the corps of Marine Cadets at Cronstadt, with a salary double that of his predecessor, and the rank of Lieutenant-Colonel attached to it. This corps consisted of about 400 Russian noblemen, who were educated by 40 masters and professors, and it was Mr. Robison's duty to receive the reports of the teachers, and to class the cadets in the order of their merit.

Upon the death of Dr. Russell in 1773, Principal Robertson, though not personally acquainted with our author, recommended him to the vacant chair of natural philosophy in the University. The patrons of the University readily yielded to this recommendation, and as the Russian government offered to increase the salary and appointments of Mr. Robison, it was with some difficulty that he came to the resolution of settling in his native country, and of sitting in the next chair to Dr. Black. Finding it in vain to offer any farther inducement to detain him in Russia, the Empress gave him a pension of £80 per annum, accompanied with a request that he would take under his care two or three of the young cadets, who were to be selected in succession. Mr. Robison left Cronstadt in June 1774. He was admitted into the College on the 16th September 1774, and delivered his first course of lectures in the following winter. The system of mechanical philosophy which he taught, embraced dynamics, astronomy, mechanics, hydrodynamics, optics, electricity, and magnetism; but he generally enlarged so much upon the early subjects of his lectures, that some of the last of these series were every year omitted entirely in the course. When we consider that a great proportion of the students of this class are students of divinity, from 15 to 17 years of age, who require a general knowledge of natural philosophy, it is not difficult to point out the nature of the course which should be pursued. Mr. Robison always supposed a degree of mathematical knowledge among his students which they never possessed, and even if they had gone through the requisite course, either at the University or with private masters, it by no means followed that they were able to bring this knowledge to bear in following a train of oral reasoning. In consequence of this, and of the small number of experiments which he introduced, and which he held as very subordinate parts of his lecture, his students, with the exception of a few, made very little progress in the physical sciences.

Although Mr. Robison's lectures had thus an unpopular aspect, yet they were listened to with delight by those who had devoted their minds to the subject; and who now consider themselves fortunate in having attended the University, when he had health enough to go through the labours of the course. Dr. Robison never condescended to become a dealer in scientific shows, to amuse his students with the exhibition of trifling instruments and experiments, fit only for the nursery, to occupy their time with conceits and extravagancies of his own; to falsify the history of science for the purpose of elevating himself, or to sneer at those venerable men whose names have been consecrated by time, and those revered opinions which have commanded the assent of the wisest as well as the best ages of the world. Like his eminent successor in the chair, Professor Playfair, his great object was to instruct his students in the sciences, to give just and candid estimates of the labours of others, and to impress upon the minds of the young those great lessons of humility and piety, which the study of the material world is so well calculated to teach.

Soon after his return from Russia, Mr. Robison became a member of the Philosophical Society, which had existed since 1739. When it was incorporated with the Royal Society, which was established in 1781, Mr. Robison was appointed general secretary, and continued to discharge the duties of that office till the state of his health compelled him to resign.

It is a curious circumstance, that Professor Robison never appeared as an author, till the year 1786, when, in the 47th year of his age, he published in the Transactions of the Royal Society of Edinburgh, *A determination of the orbit and the motion of the Georgium Sidus, directly from observation.* The elements of the orbit of this planet, though deduced from observations made with an instrument fixed from a window, do not differ widely from those which have more recently been obtained from more numerous observations, and by means of better instruments.

The second, and the only other paper which Professor Robison communicated to the Royal Society of Edinburgh, was read on the 7th April, 1788, and is entitled, *On the Motion of Light, as affected by Refracting and Reflecting Substances, which are also in motion*, and relates principally to the correction of some errors of Boscovich respecting the effects of a telescope, the tube of which is filled with water instead of air, upon the aberration of light. The celebrated Italian philosopher had rashly announced that if a water telescope were directed to a terrestrial object properly situated, it will deviate from that object by a certain determinate quantity every day; but Professor Robison has shown that this result is not deducible from Boscovich's own principles.

This paper was drawn up when Mr. Robison was in very bad health; and for the purpose, as he remarks, "of ascertaining his claims to any thing which may be valuable in his speculations." He had been attacked, in December 1785, with a severe disorder, which baffled all the skill of his medical friends, and which, though it did not materially injure his general health, continued to afflict him during the rest of his life.

Notwithstanding this indisposition, he engaged, about the year 1793, to contribute various scientific articles to the edition of the Encyclopedia Britannica, which was then publishing. This work never had been under the charge of any literary or scientific man, till it came under the management of Dr. Gleig; and therefore the aid of such an editor and of such a contributor as Dr. Robison, formed an era in its history. Dr. Robison revised and enlarged the article *Optics*, which was followed by the article *Philosophy*, which he wrote jointly with Dr. Gleig. His own articles are, *Physics*, *Pneumatics*, *Precession*, *Projectiles*, *Pumps*, *Resistance*, *Rivers*, *Roof*, *Ropemaking*, *Rotation*, *Seamanship*, *Signal*, *Sound*, *Specific Gravity*, *Statics*, *Steam*, *Steam-Engine*, *Steelyard*, *Strength of Materials*, *Telescope*, *Tide*, *Trumpet*, *Variation*, and *Waterworks*. In a bound copy of Mr. Robison's articles, labelled with his own hand, and now before us, we find the articles *Perspective*, *Plough*, and *Russia*, which it is probable he also wrote.

A Supplement to the third edition of the Encyclopedia Britannica was published some time afterwards by different proprietors, and to this work Mr. Robison contributed the following articles: *Arch*, *Astronomy*, *Boscovich's Theory*, *Carpentry*, *Centre*, *Dynamics*, *Electricity*, *Impulsion*, *Involution*, *Machinery*, *Magnetism*, *Mechanics*, *Percussion*, *Piano-Forte*, *Position*, *Temperament*, *Thunder*, *Trumpet*, *Tschirnhaus*, and *Watchwork*.

"To those who may examine," says Dr. Brewster, in his preface to Dr. Robison's *System of Mechanical Philosophy*, "these dissertations with a critical eye, it may be necessary to state, that they were composed under the influence of that painful disease, with which he was afflicted for a long period of years. The knowledge of mechanical philosophy which they everywhere display, possesses the rare quality of being at once practical and profound; and they are often enriched with original views, and ingenious inventions, which it required only the tranquillity of health to perfect and mature. It was his destiny, however, to enjoy but at distant intervals that calm of mind which can alone sustain the ardour of discovery. At such periods his ambition constantly reverted to those original pursuits which he was desirous of bringing to a close; but they were no sooner begun than they were interrupted by renewed attacks of that disease which ultimately deprived him of his life."

To these observations it may be added, that as Dr. Robison had no scientific articles of any value to refer to in the previous part of the work, he was obliged to introduce preliminary discussions as portions of the treatise which he was writing, and from this cause the articles are destitute of that symmetry and method which would otherwise have characterised them.

In the midst of these occupations, Dr. Robison was led to compose a work of a very different nature, which he published in 1797, under the title of *Proofs of a Conspiracy against all the Religions and Governments of Europe.* On his way to St. Petersburg in 1770, he and Admiral Knowles were entertained by the Prince Bishop of Liege, who, with his chapter and all his servants constituted a lodge of freemasons. Mr. Robison was here initiated into the mysteries of the fraternity, and was thus led, during his residence abroad, to examine the nature and character of such institutions. This work, which consists principally of the history of the society of Illuminati, and the German Union, was founded on documents, the truth of which Dr. Robison had no reason to call in question; but which were undoubtedly not deserving of implicit confidence. The work was read with avidity in every part of Europe. It underwent four editions in two years, and extended his reputation among a class of readers who had never heard of the fame of his talents, and who were incapable of appreciating them, even if they had been known.

Upon the death of Dr. Black in 1799, Dr. Robison was applied to by his friends to superintend the publication of the lectures of that eminent chemist. Dr. Robison cheerfully undertook a task which, at his time of life, and from other causes, was by no means an easy one. Dr. Black had discovered so much, and written so little, that this publication became necessary to establish Dr. Black's claim to the great discovery of latent heat. This work, which was published in 1803, in 2 vols. 4to. though well executed, was too late in making its appearance. Chemistry had undergone a complete revolution, and even the lectures of Dr. Black were received with comparatively little interest. The last work which Dr. Robison lived to publish, was the first volume of his *Elements of Mechanical Philosophy; being the Substance of a Course of Lectures on that Science.* This volume, including Dynamics and Astronomy, was published in 1804; and he had proceeded a considerable way in preparing the manuscript of the second volume, when, after delivering a lecture on the 28th of January, he was seized with a slight cold, and died on the 30th January, 1805, in the 66th year of his age.

Dr. Robison was in stature considerably above the middle size. His person as well as features were uncommonly handsome, and his physiognomy noble and dignified, yet subdued by a tenderness of expression characterising the natural benevolence of his nature; but deepened with a tinge of sorrow which his fine features had gradually derived from his bodily infirmities.*

The effect of these external qualities was sustained by the elegance of his manners, as well as by his powers of conversation, and the extent of his general knowledge. Having mixed much with the world, and conversed much before he began to write, his written style partakes a little of the ease, and fluency, and diffuseness of conversation; while among his scientific countrymen, who generally write long before they have mixed much with society, it is more customary to find their conversation marked with the stiffness and formality of written language.

After Dr. Robison's death, Professor Playfair undertook to draw up an account of the life and writings of his friend, and to edite a collection of his various articles in the Encyclopedia. The first of these tasks Mr. Playfair executed with his usual ability, but his occupations would not permit him to execute the second. It therefore devolved upon Dr. Brewster, one of Dr. Robison's pupils, to publish these papers in 1822, under the title of *A System of Mechanical Philosophy*, in 4 vol. 8vo. with a volume of plates. This work includes the first volume already mentioned as having been published in 1804, and some manuscripts which were intended for a second volume of the same work, together with all the leading articles which had appeared in the Encyclopedia Britannica, and in the Supplement to the third edition of it. As Dr. Brewster was obliged, from the wishes of the publisher, to limit the work to four volumes, he was compelled to leave out several of the inferior articles, and to exercise a considerable editorial jurisdiction over the rest. This work, as Mr. Playfair has justly remarked, will place his scientific character higher than it has ever been with any but those who were personally acquainted with him. In addition to several notes written by himself, the editor was fortunate in being able to prevail upon the late eminent Mr. James Watt to undertake the revision of the article Steam-Engine; and though he intended only to correct imperfections, and supply some of the most prominent defects, yet he was gradually led to extend his views, and to compose most valuable additions on the history, the principles, and the construction of the steam-engine.

Practical and useful as all the writings of Dr. Robison are, we are disposed to think that they are still too profound for general readers, and that their popularity, however great, would still have been heightened by the omission of several of the mathematical disquisitions. Dr. Thomas Young, however, has expressed an opinion which may be considered as the reverse of this, when he says that Professor Robison, as well as many others of his countrymen, would certainly have been the better of *a little more* pure mathematics. We are not disposed to controvert what in its literal signification is so very true; but we may be permitted to oppose it with another observation equally true, that many of their friends in England would also be the better of a little more of the same rare commodity. With the exception of Mr. Ivory and Professor Wallace, we willingly admit the inferiority of our countrymen in mathematical attainments; but if the observation is meant to convey the idea that Dr. Robi-

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* There are two fine portraits of Dr. Robison from the hand of Sir Henry Raeburn, and from one of them a mezzotinto drawing has been executed.

Robison, John, Rochdale.

son or any of his countrymen, would have made more discoveries in chemical and physical science, had they been more profound mathematicians, we venture with much deference to doubt its accuracy. The history of British science will, we think, establish the opposite opinion; and the names of Priestley, Watt, Black, James Hutton, Herschel, Dollond, Blair, Ramsden, Troughton, Wollaston, and Sir Humphry Davy, none of whom ever pretended to be great mathematicians, require only to be mentioned, to give this opinion the character of demonstration. That a profound knowledge of pure mathematics would have been useful to all these illustrious men, after they had begun their career of invention and discovery, and fairly grappled with the difficulties of original investigation, it would be idle to deny; but we humbly conceive that there is in that turn of mind which disposes it to seek its gratification in the abstractions of the higher mathematics, something incompatible with that genius for invention and discovery which limits its ambition to the study of the material universe.

We shall conclude this account of Dr. Robison's life with a brief sketch of his character, as drawn by Dr. Brewster, in his preface to the work above mentioned. "Although Dr. Robison's name cannot be associated with the great discoveries of the century which he adorned, yet the memory of his talents and his virtues will be long cherished by his country. Imbued with the genuine spirit of the philosophy which he taught, he was one of the warmest patrons of genius, wherever it was found. His mind was nobly elevated above the mean jealousies of rival ambition; and his love of science and of justice was too ardent to allow him either to depreciate the labours of others, or transfer them to himself. To these great qualities as a philosopher, Dr. Robison added all the more estimable endowments of domestic and social life. His friendship was at all times generous and sincere. His piety was ardent and unostentatious. His patriotism was of the most pure and exalted character; and, like the immortal Newton, whose memory he cherished with a peculiar reverence, he was pre-eminently entitled to the appellation of a Christian patriot and philosopher."

Dr. Robison was survived by Mrs. Robison, and a family of three sons and a daughter. His daughter, who died a few years ago, was married to the late Lord Kinedder. His eldest son, who has returned from India, inherits the talents of his father, and now fills the situation of Secretary to the Society of Arts for Scotland, and Secretary to the Physical Class of the Royal Society of Edinburgh.

ROCHDALE, a market town of England, in the county of Lancaster, is situated at the foot of the Blackstone edge hills, occupying two valleys formed by the Roche and Spaddon rivers; over the first of which there is a good stone bridge of three arches. It consists of three principal streets, and several small and irregular ones, which are paved. The houses, which are in general well built of stone, are covered with slates. The chief public buildings are the church and chapel of the parish, a cloth hall, a theatre, an assembly room; besides chapels for presbyterians, baptists, and methodists. The church, which is an ancient building with a square tower, stands on an eminence which is ascended by 126 steps. Another church, in the Gothic style, has recently been built of stone. The manufactures, which have increased very rapidly, are baize, flannels, kerseys, coatings, cloths, muslins, and cottons. The parish is rich in slate, stone, and coal.

The Rochdale canal, which has contributed greatly to the prosperity of the town, has been already described in our article NAVIGATION INLAND, Vol. XV. p. 249, col. 1. Population 14,000. See the *Beauties of England and Wales*, vol. ix. p. 298.

ROCHEFORT, a town of France, in the department of Lower Charente, is situated on the right bank of the river Charente, about five miles above its influx into the Atlantic. The town has the form of a circular segment, the river forming the chord, and the walls the arch. The streets, which are built after a regular plan, are broad and straight. The Place d'Armes is a spacious square, nearly in the centre of the town. Besides several churches and convents, Rochefort has an arsenal, a cannon foundry, barracks, magazines of naval stores, docks for building, careening and refitting vessels, a civil and marine hospital, and a marine academy. The harbour, which is one of the greatest naval stations in the kingdom, is defended by five forts. Even at low water large vessels float, and it is protected from all hurricanes, and from all attacks of bombs. It is said that the worms, which are so destructive to ships' bottoms, do not affect them here. Rochefort carries on a coasting and colonial trade. Its manufactures are those of oil, earthen-ware, cordage, and the refining of sugar. There is a good promenade on the ramparts, which are planted with trees. Population 15,000.

ROCHEFOUCAULT, FRANCIS DUKE DE, Prince of Marsillac, was born in 1613. Having formed a connection with the Duchess de Longueville, he was at her instigation involved in the civil war of the Fronde; and he distinguished himself at the battle of St. Antoine, where he received a musket shot which for some time deprived him of his sight. After his return home, his house became the resort of all the French wits, Boileau, Racine, Sevigné, and Fayette, &c. He displayed great firmness of mind under his domestic calamities, particularly when one of his sons was killed, and the other wounded, at the passage of the Rhine. In his latter days he was much afflicted with the gout, and he died at Paris in 1680, in the 68th year of his age.

The work by which he obtained his reputation, is entitled *Réflexions et Maximes*, which has been frequently printed and translated. Its style and general character have been greatly admired; but though it is admitted that he painted very exactly the world in which he himself lived, it is still considered by some as a satire upon the human race; though we fear this is one of those cases where the profound observer sees the proofs of the law, and the superficial one only its exceptions. He wrote also *Mémoires de la Régence d'Anne d'Autriche*, in two vols. 12mo. 1713, which is said to exhibit much talent.

In his *History of the French Academy*, the Abbé Olivet assures us, that though Rochefoucault was very anxious to be an academician, and could at any time have been made one, the necessity of making a speech of thanks on the day of his admission, prevented him from becoming a candidate. With all his personal courage, and all his superiority of birth and talents, he is said never to have been able to bear the look of an audience, and could never pronounce four lines in public without fainting.

ROCHELLE, LA, a seaport town of France, and capital of the department of Lower Charente, is situated in a marshy plain at the bottom of a small gulf of the Atlantic. The town, which is nearly of an oval form, is about three-fourths of a mile long, and half a mile broad. The streets are straight and wide, and the houses, which are well built, are supported by arcades. The chief squares are the *Place d'Armes*, and the *Place du Chateau*. The principal public edifices and establishments are the cathedral and hospital, the orphan-house, and the exchange; an academy of sciences, established in 1732, and a marine academy. The fortifications consist of nineteen large bastions, with half moons; and the circumference of its ramparts is about three miles. The entrance of the harbour, which advances into the town, is narrow, and is defended by two lofty towers, and by a massy chain. It has a mole about three-fourths of a mile in length. The exports of the place are wines, brandy, flax, linen, and bay salt; and its imports sugar, coffee, cotton, &c. Its manufactures are Delft ware, glass, and the refining of sugar. West long. 1° 9′ 40″. North lat. 46 9′ 21″.

ROCHESTER, a city of England, in the county of Kent, is situated on the east bank of the Medway, on a bend of the river, where it falls into the Thames. A continuous row of buildings connects it with Chatham, and by a bridge over the Medway it communicates with the village of Stroud. The town consists principally of the high street, along which passes the great road from Canterbury to Dover. The streets are wide, well paved, and lighted with gas; and the houses are in general well built. The principal public buildings and establishments are the castle, the cathedral, the churches, the town-hall, the hospital, a grammar school, and alms-house for poor travellers, and a free school.

The castle is situated at the south-west angle of the city, and is defended on the west by the Medway, from which it rises abruptly, while a broad and deep ditch protects it on all other sides. The external walls, which once formed an irregular parallelogram about 300 feet long, were strengthened with round and square towers, which, with the walls themselves, are in a state of ruin. The keep has the form of a quadrangle, seventy feet square at the base, with the angles directed to the four cardinal points, and upon which angles there were four elevated towers. The interior of the keep is divided into two nearly equal parts by a strong wall, with arched doorways on each floor. At the north-east angle is a circular winding stair-case, which ascends to the summit.

To the east of the castle, and a little to the south of the high street, stands the cathedral. Its shape is that of a cross, and it has a low tower and spire rising at the intersection of the nave and great transept. The west entrance is particularly fine. The roof is of timber frame-work, in imitation of vaulting. The great tower is supported by four obtusely pointed arches, resting on pieces of solid masonry, which are surrounded by slender columns of Petworth marble. The chapter-house, which contains the library, is entered by a rudely sculptured doorway. In a large hollow between the inner mouldings, is a range of human heads and flowers alternating; and beyond them are six whole length figures, two of which are supposed to be Henry I. and Matilda, and the rest bishops. There are several valuable MSS. in the library.

The cathedral is 306 feet long from east to west, 150 belonging to the nave, and 156 to the choir. The breadth of the nave, and also that of the choir, is about 75 feet. The western transept is 122 feet, and the eastern one 90 feet long. The west front is 94 feet wide, and the height of the great tower 156.

Besides the cathedral on the south, are the remains of the chapter-house and cloister belonging to the priory, which are very beautiful. There were formerly four churches at Rochester, viz. those of St. Nicholas, St. Margaret, St. Clement, and St. Mary. The last of these is demolished, and St. Clement's forms part of some houses near the bridge. The church of St. Nicholas, built in 1421, consists of a nave, aisle, and chancel, and has an embattled tower at the north-west angle. St. Margaret's is finely situated on a lofty eminence south of the high street. The town-hall, erected in 1687, and situated on the north side of the high street, is an elegant building of brick, ornamented with Doric columns. The city jail is in the lower, and the town-hall in the upper part. A spacious room in the area behind, contains full length portraits of King William and Queen Anne. The bridge over the Medway, which is remarkable for its height, strength, and elegance, consists of about eleven arches, the largest of which is about forty feet span, and the others thirty. It is 560 feet long, and 24 broad.

The principal charitable institutions in Rochester are St. Catharine's hospital, a grammar school, an alms-house for the relief of poor travellers, and a free school. The hospital was founded in 1316, for the maintenance of twelve poor people, by Simond Potyn. The grammar school was founded by Henry VIII. for twenty scholars; and the alms-house and dormitories for the relief of poor travellers, were built in the reign of Elizabeth by the proprietor of Satis, who left estates for its support. The free school was founded by Sir Joseph Williamson, who bequeathed to it, in 1701, £5000. Rochester is governed by a mayor, twelve aldermen, twelve councillors, a recorder, town-clerk, two chamberlains, a principal sergeant at mace, a water bailiff, and other inferior officers. The oyster fishery in the Medway is managed by a company of dredgers. The spawn is often brought from foreign parts, and after being laid in proper beds, soon arrives at maturity. The inhabitants are principally occupied in trade and maritime pursuits.

Rochester sends to parliament two members, who are elected by about 1050 voters.

Chatham. The town of Chatham, for a description of which we have referred to this article, forms in reality a part of Rochester. It is an irregular and ill-built town, standing immediately to the east of Rochester, and derives its celebrity from its dock-yard and arsenal, which cover an area about a mile long to the north of the town. The dock-yard, which is inclosed by a high wall, has a spacious gateway with embattled towers. The commissioner and officers have large and handsome houses. The houses for stores and masts are very extensive. One of the store-houses is 660 feet long, and contains prodigious quantities of sails, rigging, hemp, flax, pitch, and all other naval stores, for the equipment and building of ships. The principal mast-house is 240 feet long, and 120 wide; and the timbers which form the masts are kept continually afloat in two spacious basons. The rope-house is 240 feet long. The sail-loft is about 210 feet long. There are four wet docks fit for first rates, besides six slips or launches. The smith's shop contains about twenty forges. The number of artificers and labourers was about 3000 or 4000 in 1808. The ordinance wharf, or old dock, occupies a narrow slip of land below the chalk cliff. Great quantities of naval ordnance, cannon balls, gun carriages, &c. are deposited here, with quantities of pistols, cutlasses, pikes, &c. Since 1758, extensive fortifications, called the *Lines*, have been erected from the banks of the Med-

Rochon, Alexis-Marie.

way above the ordnance wharf, round an oblong plot of ground about a mile broad and half a mile wide, and extending beyond the extremity of the dock-yard, where they again join the river. This area includes, besides the naval establishments, the upper and lower barracks, the church of Chatham, and the hamlet of Brompton, containing nearly 500 houses. The Lines are strengthened by ramparts, pallisadoes, and a deep broad ditch, and are also defended by a strong redoubt on the summit of the hill to the south-east.

The church of Chatham, rebuilt in 1788, is a neat building of brick. The west wall formed part of the ancient Norman church. There are at Chatham two hospitals, one founded in 1078 for poor leprous persons; and another in 1592, for decayed mariners and ship-wrights.

The victualling house stands near the entrance of the town, near Rochester, and consists of various extensive ranges of building, suited to the various purposes of victualling the shipping of Chatham, Sheerness, and the Nore.

The following was the population, &c. of the town of Chatham and the city of Rochester in the year 1821:

Inhabited houses - - - - -	4135
Families - - - - -	5336
Do. employed in agriculture - -	385
Do. do. trade, &c. - - - -	2701
Males - - - - -	11,245
Females - - - -	12,818
Total population in 1821 - -	24,063

See the *Beauties of England and Wales*, p. 611, 666, and Hasted's *History, &c. of Kent*.

ROCHON, Alexis-Marie, member of the Royal Academy of Sciences, was born at Brest on the 21st Feb. 1741. From his residence at Brest, in the midst of ships and sailors, he acquired an early taste for the objects of naval science. In 1765, he was named corresponding member of the Academy of Sciences. Some time afterwards he was appointed astronomer to the navy, and in that capacity he performed a voyage to Morocco, in 1767; and immediately upon his return to Europe, he set out for the East Indies, in a vessel commanded by his friend and relation M. de Fromelin; and during that voyage, in 1769, he determined the position of the islands and rocks between the Mauritius and the Indian coast.

Upon his return from the Mauritius, in 1772, with M. de Poivre, M. Rochon brought from Madagascar the finest crystals of quartz that had at that time been seen. This accidental circumstance led him to ascertain its double refraction, and by the combination of two prisms, cut in a particular manner, he measured the double refraction, so as to apply it to the purpose of a double image micrometer. This idea he first applied to a coming-up glass, for ascertaining whether a ship was approaching to, or receding from the observer. A full account of the invention was published at Paris in 1807, in a pamphlet entitled, *Mémoire sur le Micrometre de Cristal de Roche, pour la mesure des distances et des grandeurs*. In the year 1812, he laid before the Institute an account of an improvement upon the micrometer; and in the same year he read a memoir, recommending the substitution of mica in place of glass, in the different light-houses of France. He was led to this idea, from the circumstance of a flock of wild ducks having, in a dreadful tempest, thrown themselves against the glass frame, broke the panes of glass, and caused the light to be extinguished. These panes were immediately replaced by Rochon with squares of mica.

M. Rochon had the merit of proposing the canal from Brest to Nantes across Brittany. He was made a member of the legion of honour by Bonaparte; and he died in the 77th year of his age at Paris, and was buried on the 7th April 1817. In 1783, Rochon published a work, entitled *Recueil de Mémoires sur la Méchanique et la Physique*. See Dr. Brewster's *Treatise on New Philosophical Instruments*, p. 188, 189, note. See also our articles Micrometer, Vol. XIV. p. 213, and Optics, Vol. XV. p. 654.

ROCKS. See Mineralogy, Vol. XIV; Organic Remains, Vol. XV; and Theories of the Earth, Vol. XVIII.

ROCKETS. See Pyrotechny, Vol. XVII. p. 278.

RODNEY, George Brydges, a celebrated British admiral, the second son of Henry Rodney, Esq. of Walton-upon-Thames, was born in 1718. In 1742 he was appointed Lieutenant of the Namur, and afterwards to other ships, in which he rose to considerable distinction in his profession. In 1759 he accompanied Admirals Hawke and Boscawen in their attempt upon the French coast; and in 1759 he was appointed Rear-Admiral of the Blue. In the same year he was sent to bombard Havre-de-Grace, and he succeeded in burning the town, and the magazines of stores and ammunition. In 1761 he assisted at the capture of the French West India Islands; and at the conclusion of the war he was raised to the dignity of a baronet. In consequence of a contested election for Northampton, in which he was successful against Mr. Howe, Sir George Rodney injured his affairs to such a degree, that he retired to France. Through the Duke de Biron, the French king endeavoured to allure him into the French service by high pecuniary offers. "My distresses, he replied, have exiled me from my country, but no temptation can estrange me from her service. Had this offer been voluntary on your part, I should have deemed it an insult; but I am glad to learn that it proceeds from a source that can do no wrong." The Duke de Biron ever afterwards entertained the warmest friendship for the British Admiral.

About the end of 1779, he obtained the chief command of the Leeward islands, and such was his success on this station, that he received a vote of thanks from the House of Lords, and the freedom of the cities of London and Edinburgh.

His great victory over the French fleet, of which we have already given a short account, under Britain, Vol. IV. p. 651, was gained on the 12th April 1782.

This victory was gained by putting in practice the method of breaking the enemy's line, invented by the late Mr. Clerk of Eldin. Admiral Rodney's own ship, the Formidable, kept close to the wind, and an opening being observed near the enemy's centre, it broke through at the head of the rear division, and the enemy's line was for the first time cut in two. "This action," says Professor Playfair, in his Memoir of Mr. Clerk, "introduced a new system, gave a turn to our affairs at sea, and delivered our country from that state of depression into which it had been thrown, not by the defeat of its fleets, but by their entire want of success."

"It was in the beginning of that year that the *Naval Tactics* appeared in print, though for more than a year before, copies of the book had been in circulation among Mr. Clerk's friends.[*] Before going out to take the command of the fleet in the West Indies, Admiral Rodney said one day to Mr. Dundas, "There is one Clerk, a countryman of yours, who has taught us how to fight, and appears to know more of the matter than any of us. If ever I meet the French fleet, I intend to try his way."

That Admiral Rodney did try Mr. Clerk's method, we have the testimony both of Lord Melville and General Ross, who heard the Admiral distinctly state, "that he owed his success in the West Indies to the manœuvre of breaking the line, which he learned from Mr. Clerk's book."

"An anecdote," says Mr. Playfair, "which sets a seal on the great and decisive testimony of the noble Admiral, is worthy of being remembered, and I am glad to be able to record it, on the authority of a noble Earl. The present Lord Haddington met Lord Rodney at Spa, in the decline of life, when both his bodily and his mental powers were sinking under the weight of years. The great commander, who had been the bulwark of his country, and the terror of his enemies, lay stretched on his couch, while the memory of his own exploits seemed the only thing that interested his feelings, or afforded a subject for conversation. In that situation he would often break out in praise of the Naval Tactics, exclaiming with great earnestness, "John Clerk of Eldin for ever."

As a reward for this brilliant victory, Sir George Rodney was created a Peer of Great Britain, with the title of Baron Rodney of Rodney-Stoke, in the county of Somerset, and to this title was added a pension of £2000 a-year, to descend to his heirs. He died in London, on the 24th May 1792, in the 74th year of his age. See our article BRITAIN, Stockdale's edition of Campbell's *Lives of the Admirals*, and the *Edinburgh Transactions*, Vol. IX. p. 127.

RODOLPH I. See AUSTRIA, Vol. III. p. 135.

ROEBUCK, JOHN, an eminent physician, and a great benefactor to Scotland, was born in Sheffield, in 1718. Having completed his clerical education under Dr. Doddridge of Northampton, he studied medicine and chemistry at Edinburgh, from whence he went to Leyden, and took his degree of M. D. in 1743.

After his return from the continent, he settled as a physician at Birmingham, where the rising science of chemistry attracted his particular attention. In a small laboratory which he fitted up, he spent all his leisure hours; and one of his first discoveries was a new method of refining gold and silver, and of collecting the smaller particles of these precious metals, which had previously been lost. He discovered an improved method of making sublimated hartshorn, and other articles of great use. Having associated himself with Mr. Samuel Garbut of Birmingham, they established a laboratory on a large scale, and after they had discovered a method of making sulphuric acid in vessels of lead in place of glass, they established, in 1749, the manufacture of sulphuric acid, which still exists at Preston Pans, about nine miles to the east of Edinburgh. Scotland now became the principal residence of our author, and he here conceived the great project of establishing an extensive manufactory of iron; and having fixed upon Carron as the most appropriate site for it, he obtained plans, &c. of the machinery from Mr. Smeaton. The preparations for that great national establishment were completed in 1757. (See our article CARRON WORKS, Vol. V. p. 554, for an account of the establishment.)

Roebuck, Roemer, Olaus.

When this work was fairly under the routine of its ordinary managers, Dr. Roebuck took a lease of the Duke of Hamilton's extensive coal and salt works at Borrowstounness; but after many years of labour and industry, the speculation turned out a most ruinous one, after he had sunk in it his own and his wife's fortune, as well as numerous sums borrowed from his relations and friends. After withdrawing his capital from the refining work at Birmingham, the vitriol work at Prestonpans, the iron works at Carron, and parted with his interest in the project of improving the steam engine in which he had become a partner with Mr. Watt, he was allowed by his creditors to draw from his colliery a moderate annual maintenance for himself and his family during his life.

These disasters produced a great effect upon his spirits. He was attacked with a complaint which required a dangerous surgical operation, which he supported with his usual resolution. The effect of it, however, never left him, and after being a few days confined to bed, he died on the 17th July 1799, in the 76th year of his age.

Dr. Roebuck was a member of the Philosophical Society of Edinburgh, and became a member of the Royal Society at its establishment in 1783. He read to the Royal Society of Edinburgh the following papers:—

1. Observations on the ripening and filling of corn. Read January 5th, 1784. He found that corn ripened at a temperature of 43°, and he advises farmers to be cautious in cutting down their unripe corn on the false supposition that in a cold autumn it could fill no more.

2. Account of certain phenomena observed in the air vault of the furnaces of the Devon iron works, together with some practical remarks on the management of blast furnaces. In a letter to Sir James Hall, Bart. Read July 2d, 1798. *Edinburgh Transactions*, Vol. V. p. 31. See also the article BLOWING in this work, Vol. III. p. 615-16.

Dr. Roebuck was elected a fellow of the Royal Society of London on the 12th July, 1764, and he printed in the *Philosophical Transactions* the following papers:

1. A comparison of the heat of London and Edinburgh. *Philosophical Transactions*, 1775, Vol. 65, p. 459.

2. Experiments in ignited bodies. *Philosophical Transactions*, 1776, Vol. 66, p. 509.

ROEMER OLAUS, a celebrated Danish astronomer, was born at Aarhusen in Jutland, in 1644. He studied mathematics at the university of Copenhagen, and such had been his progress, that Picard and Cassini employed him in 1671, and on their return from their astronomical observations, they carried him along with them to Paris, where he was received as a member of the Royal Academy of Sciences in 1672. In this capital he resided ten years, during which time he made his great discovery of the velocity of light, of which we have given an account in our articles ASTRONOMY and OPTICS. Here he also discovered the application of the epicycloidal curve to the teeth of wheels, as described in our article on MECHANICS.

In 1681, Christian V. appointed him professor of

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[*] In the library of Sir George Clerk, Bart. at Pennicuik, there is a copy of the Naval Tactics, with marginal notes by Lord Rodney. These notes are full of remarks on the justness of Mr. Clerk's views, and contain examples where his own conduct had been conformable with them.

Resemblances and contrasts between the early poetry of the ancient world and the modern.

The earliest fictitious narrative of the ancients, and that of the moderns, were both grounded on the achievements of war. They both called into their service the machinery of supernatural beings—and that machinery is in the two cases wonderfully similar as to all points of real importance, witchcraft, incantation, charms, dreams, prophecies, local spirits, &c. &c. being common to both. The purpose being, under whatever veil of cloud, ornament, and figure, to represent human life, love, of course, forms a principal topic in each class. But here comes the great line of demarcation. Love was idealised and elevated into an all but heavenly character among the nations where the institutions of chivalry had their origin. Here is not the place to trace the causes of this—but such is, and such is universally admitted to be the fact; —whereas love among the people of classical antiquity preserved, from the earliest period in which we can trace their history, a character of much greater coarseness. Their women were their slaves—the objects of every kind of passion, but not of intellectual respect and reverence. Such reverence was, in a great measure, extended among the other peoples, even to those of the fair sex who could not be considered as perfect models of purity—it breathed an air of lofty and generous courtesy over every situation in which man could be brought into contact with the fortunes of the feebler sex. On the other hand, even in the highest æra of Greek romance, even an Andromache, pure and spotless, royally born, and universally esteemed, is represented even by a Greek poet, as neither expecting, nor having any reason to expect, any better fate, in case Troy were taken, than that of forming part of the haram of some Greek Prince. There is nothing so rude as this, even in the old German romances, which celebrate the achievements of Attila; and it would be worse than idle to show how diametrically such a conception is at variance with the tone of sentiment that predominates over the works of the same class, which belong to the other two great cycles of heroes, illustrious in the historical romance of our Gothic ancestors. It is in this alone that we find the essential difference between these two classes of imaginative literature. It is a difference which is equally discernible in every branch of modern European *Literature* (properly so called), which we have the means of comparing with any class of works composed for similar purposes among the classic peoples of the ancient world. It has always, in fact, formed the great distinction between all ancient poetry, and all modern poetry, worthy of being talked of as such; nay, it forms to this day the great distinction between the actual manners of the ancient world and those of the modern.

History of the European Romance.

We may now proceed to notice briefly the different classes of fictitious narrative which have successively found favour in modern Europe;—those various classes of composition which are in common parlance considered as included within the application of the term **Romance**. But before entering on this, it is necessary to observe a general fact—at first glance strange and even inexplicable—viz. that unquestionable though it be, that among each of the Gothic tribes the first exertions of imagination were bestowed on the adorning of the legends, proper and peculiar to the tribe itself, it is still certain that no one nation or tribe of them all can at this hour point to its oldest existing Romantic Literature, and say, Behold the genuine unadulterated tribute paid by our ancestors to the greatness of the founders and original heroes of our own race. The Germans must produce the Nibelungen-lied and Heldenbuch—but some of the noblest heroes of these are not Germans but Huns—the very chieftains who conquered many of the fairest provinces of their country under the guidance of Attila. The men of Normandy must produce the romances in which Charlemagne and Roland, and the rest of that cycle flourish—but these heroes were not Norman heroes, but the heroic ancestors of the very people whose territory the Normans ravaged, and in part seized. The third great division of historical romance, is that in which Arthur and the knights of his round table are celebrated; but the first compositions of this class were to all appearance framed for the amusement of the Norman Court of England—or, if the Tristram of Thomas the Rymer be the earliest of them all, that was still the work of a poet, who neither wrote in the language, nor to flatter the taste of the British or Armorican descendants of the race among which the historical Arthur flourished.

The facility with which one nation borrows and adopts the heroic legends of another, is illustrated in every literature, or very nearly so, that we know of. By such adoption those whose business it is to minister to the delight of others by the composition of romantic narratives, find of course their own labour much lightened: nay even those whose genius sets them above this consideration, are tempted to the same practice by the superior field which it obviously opens for the introduction of that marvellous which in early and rude times must always form the most engaging condiment in such manufacture. Be this as it may, however, the facts we have above stated are undeniable—and equally so is the still stronger one, that from the remotest times until this very day, the favourite and flower of Persian romance is, under the name of Iskendar, that very Alexander who overthrew the empire of old Persia. So catching indeed has this contagion been always felt to be, that we know Mahomet himself was at considerable pains to prevent the same "Macedonian madman" from being adopted in a similar way by the minstrels of his own Arabia.

It would appear, however, that at least two causes of a more particular nature must have operated to a great extent in the adoption of these foreign legends by the different romances of modern Europe. The first of these we take to be this: that in the original imaginative or romantic compositions of all these nations. the mythological apparatus employed must, of course. have been heathen, and that when Christianity had been introduced among them, there was more to disgust than to attract in the rude and bloody character of that apparatus. The heroes themselves, moreover, must have been represented as stained with traits of character extremely offensive to the Christian priests, who, being in possession of almost all the knowledge of the times, must soon have exerted, directly or indirectly, a commanding and controlling influence over its literature. It is only in considerations of this sort that we can find a satisfactory explanation of the substitution of Charlemagne and his captains, for the northern ancestors of those who took possession of the fine province of Neustria, and thence extended their arms, and, with their arms, these their newly adopted legends to England and to Sicily. The same thing may be said of the banishment of the old Saxon legends, and the assumption of those of the Christian Arthur in England; and precisely the same thing may be said of the adoption of the heroes of the Nibelungen-lied, in place of the original heathen Hermanns, &c. among the Germans.

Another, and scarcely perhaps a less powerful cause, must have operated in two at least of the cases we have referred to. The tribes who made conquests in those days were always far ruder in manners, and of course in language, than those who were obliged to submit to their arms. Such conquerors in all cases soon borrow from the civilisation of those whom they have subdued. The Saxon pirates, and subsequently the old Norman sea-kings, must have felt themselves to be savages in comparison with those whom they deprived of the soil of England,—a country which had for centuries partaken in the light of Roman cultivation. The Normans, when they invaded Neustria, to which they afterwards gave their name, must have felt the same thing in a still more serious degree; or, at all events, the feeling must have operated still more strongly with them, since they were led to adopt so much more of the language of their new vassals. This must have facilitated to a great extent the adoption of the more polished and adorned legends which these rude warriors found in possession of the conquered soil.

There is indeed one exception, which we ought perhaps to have mentioned ere now; we mean that which is to be found in the existence of certain real old heathen legends in the literature of Scandinavia. The remains of these, preserved in some of the Eddas, are no doubt extremely valuable, not only on account of the high poetical merit which they exhibit, but still more of the light they throw on the ancient life of kindred nations, the history of whose manners we can scarcely trace to any extent worth mentioning beyond the period of their Christianization. The existence of these relics now, is however to be accounted for, only by remembering that Scandinavia was not Christianized until at a comparatively recent period, and through the agency of missionaries refined enough to take some interest in the preservation of the original traditions of the soil merely as matters of curiosity. Even in those regions, it may be added, the legends of Arthur and Charlemagne soon supplanted, generally speaking, the old heathen legends; and as, at all events, these have not exerted any discernible direct influence over the literature of modern Europe, however different may have been the case in regard to the kindred productions imported from the north at an earlier period, it may perhaps be considered as sufficient, that we have chosen to consider them as, after all, forming only an exception to a rule. The use which has recently been made of these materials by some ingenious persons in Germany, cannot deserve to be particularly commented on. That is the work of an age, in which literature is nothing but an exquisite *art*, in which the fancy is satiated with imitations of all sorts of legends, without the popular feeling being deeply worked upon by any of them. La Motte Fouqué and his brethren treat Scandinavia exactly as the authors of our own Thalabas and Kehamas do Arabia and India. Indeed, in spite of all their pretences, the Scandinavian inspiration of the modern Danish and Swedish tragedians and romancers, such as Ingelmann and Oehlenschlæger, is universally felt to be entirely of the same artificial and ineffectual character.

Considering the great length at which every the minutest item of the present subject has been discussed in separate treatises by authors of the greatest research, ingenuity, and taste, we should certainly involve ourselves in an attempt alike useless as presumptuous, if we pretended to exhaust any part of it here; or indeed, if we pretended to any thing beyond sketching, for the use of those who have not as yet entered on this wide field of study, some of the main topics to which they ought to direct their attention. We shall endeavour to do the little we pretend to with as much brevity as is possible.

Controversy as to the elements of European Romance.

All critical antiquaries, then, are at one as to the opinion of which we have been speaking above, viz. that the romantic literature was in its origin historical, and we believe they all concur in lamenting the facility with which those into whose hands it fell, soon suffered its original character and purpose to escape them. While this, however, is admitted on every hand, a world of controversies have sprung up both as to the question *whence* the historical materials, and as to that whence the mythological ornaments of the earliest romance-makers, with whose own works we have any acquaintance, were derived. One contends, that the legends of European romance were derived from the scalds of the north. Another maintains as unrivalled and alone the pretensions of the British bards. A third is of opinion, that although our ancestors might have possessed from a much earlier period a few rude strains and bloody stories of their own, yet for the whole array of fancy, the whole ornaments of pleasing wonder, the whole soul and spirit, in short, of what we now talk of as the old Gothic romance—for every thing that long made that popular, and still entitles it to be remembered—our Gothic forefathers were entirely indebted to that collision with the arts of the east, which attended their collision with eastern arms at the period of the Crusades. A fourth party, finally, attribute a similar exclusive influence to the knowledge of the works of the ancients, which was spread abroad among the Gothic nations about the same time, and in part at least in consequence of the same causes.

The older theories are erroneous, because too exclusive.

It appears to us, and we believe most impartial judges are now of the same way of thinking, that there is a great portion of truth in the essays by which each of these hypotheses has been asserted and enforced, and that the fault of each of the theories lies in its being too narrow and exclusive. We well know that there were bards among the Celtic, scalds among the Gothic, and story-tellers by profession among the oriental people, as far back as any history reaches them. We know that in consequence, first of Teutonic, then of Roman, and then again of a long series of Teutonic invasions, the population of the western countries of Europe had early acquired a very mixed character. We know that, in every instance, the conquerors and the conquered people must to a certain extent have mingled; and in the names of places, in the assumption of customs, and in the whole composition of language, we have perfect evidence that this mixture took place, in most instances, to an extent totally irreconcileable with the reveries in which some writers indulge, as to the *purity* of any of the races of man now existing in western Europe. We, therefore, cannot see any difficulty whatever in believing, that the descendants of the poets described by Tacitus in his work on Germany, and those of the poets found by Julius Cæsar in Britain and Celtic France, should have commenced an interchange of their respective legendary treasures soon, and carried it on until it might be a matter of no small difficulty for themselves to decide, whether any one given fact or fable was in its origin the property of the one race of people or of the other. In like manner we know, that the romantic literature of western Europe had not certainly gained any thing like the shape under which alone we are acquainted

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Old German romance.

Formed out of the mixture of these several kinds of materials, we have, in our European literature, three distinct bodies of romantic writing; and the most ancient of these appears from internal evidence to be that of the Germans. We say from internal evidence, and by this we mean not so much the internal evidence of style and language as that of thought and conception. In early times, compositions of this class were handed down orally from one generation to another, and of course the mere language of them was perpetually undergoing alterations. But one strong circumstance cannot be overlooked, and indeed appears to us to be conclusive. In all the existing romances of Arthur and of Charlemagne, we have the clearest traces of that peculiar spirit of religious chivalry which was first excited in western Europe in the period of the Crusades. In the Nibelungen-lied we have nothing whatever of this. The poem therefore may, as it now stands, have been the work of an age posterior to the first crusades; in all probability it was so by at least a hundred years; but the person or persons who gave to these legends their present form and dress, must have carefully followed more ancient editions of them, otherwise it seems impossible that we should be able to discover in them nothing of the anti-Saracen ardour, nothing of the idea of a chivalry formed and preserved for purposes not political and military only, but religious; nothing, in short, of that peculiar spirit which animates the far greater portion of the Norman romances connected with the traditions of Charlemagne and Arthur. Besides, the superior antiquity of the Nibelungen-lied legends is equally attested by the far less formal manner in which the institution itself of chivalry is brought forward. We have no trace of the solemn institutions and brotherhoods by which chivalry was distinguished in its perfect state; and we know enough of all the romance writers to be quite certain, that they, under whatever colouring of distance, aimed at, or at least indulged in, nothing so much as the delineation of the actual manners of their own period.

We have both heathens and Christians in these legends; but the heathens are genuine worshippers of Odin not of Mahomet, and the Christians are represented as living in peace with them, beneath the tolerating sway of Attila the Hun! A great deal of the pure old Scandinavian tone is preserved in the manners of the heroes, and in the tone of the narrative. A peculiarly dark and solemn character of melancholy pervades the whole spirit of the work. Devotion and daring are carried to their utmost height; and a rude and imperfect idea of the Christian doctrines appears to struggle throughout with elements of a very different description, softening rather than expelling the stern and iron gloom of the black and bloody creed of Scandinavian mythology. It is impossible for us to bestow more time on this singular relic of antiquity here; but we regret this the less, as we see a translation of it into the English language announced as nearly ready for publication.

The *Heldenbuch*, or Book of Heroes, which is commonly esteemed as the second great storehouse of this old German romance, is a compilation of very incongruous materials. Many of the pieces contained in it approach very closely the tone of the Nibelungen-lied, but others are obviously the productions of a later period, as they abound in allusions to the very things, the absence of all mention of which in the older collection has been already commented on. We refer our readers to the editions of these works, published by Müller, Grimm, and Haagen, and to the comments on them scattered over the works of Herder and the Schlegels.

The other two great bodies, however, of romance—those which may be generally designated by the names of Arthur and Charlemagne—are the only ones which may be said to have possessed a really European character and influence. It is by no means easy to decide which of these ought to be considered as the more ancient. The historical Arthur belonged to an age far remoter than that of the son of Pepin; and it can scarcely be doubted that the people of his own race had founded romantic narratives on his adventures almost in his own time. But the *romances* concerning him and his heroes which we now possess, were all, it is obvious, the productions of a much more recent time. They are all, in a word, distinguished by the vividness with which the manners of the most perfect age of chivalry are represented in them. Nay, many critics have gone so far as to decide against them the question, as to their relative antiquity and that of the romances of the Charlemagne body, upon this ground only, that, as they allege, the spirit of chivalry appears in them under a purer and more idealized form than in the others. Such in particular is the opinion of the great German critic, Schlegel.

This contreversy has not yet been terminated, nor do we consider it as one of any sort of importance. We now know very well, that both of these bodies of romantic fiction were arrayed in the dress which is to us their earliest, among the same nation, and in or about the same period. The sagacious guess of the Count de Tressan has been converted into all but certainty by the accurate researches of the Abbé de la Rue; and we may state with as much confidence as is attainable in any matters of the kind, that the earliest metrical romances both of the Charlemagne class and of the other were composed in Norman French, for the amusement of the Anglo-Norman court of the early Plantagenets, and their powerful barons, who, in that age held estates for the most part both in Normandy and England, and among whom the language of their old duchy was used almost exclusively for the better part of three centuries, subsequent to the invasion of William I. They are all composed in the *Langue d'Oil*.* The Abbé has traced in a vast number of instances the persons to whom they are dedicated and addressed; and, lastly, he has pointed out with such acuteness, and such convincing *tact*, the innumerable, the perpetual complimentary allusions to the power and greatness of the Anglo-Normans, that altogether the mass of evidence is quite irresistible. We refer our readers to his interesting works for the details of his masterly exposition.

Another important particular, in which these two classes of romance coincide, is this,—(we have already alluded to it)—that the great and leading inspiration of both, seems to lie in the representation of Christian knighthood arrayed against the spirit of paganism. In both, we have a great monarch surrounded by a cycle of knightly brothers, all living under the rules of an established brotherhood of chivalry. The great object of both cycles, is the assertion of the cause of Christ against that of a warlike race of misbelievers. Arthur and his knights are opposed to the bloody heathenism of the Saxon hordes, who invaded the civilized, in so far at least, and christianized provinces of Britain. Charlemagne, and the peers of his cycle, are opposed in precisely the same manner to the Mahometans, who, in the days of the historical Charlemagne, certainly threatened to obliterate every trace of western civilization, and to eradicate the Christian faith from the soil of Europe. This is the great and presiding idea in these two kindred classes of romance; and the picture is filled up in them both with materials and colourings of a wonderfully similar nature. In each, the monarch knight forms the centre of a band of brothers, among whom the great and leading diversities of human character and disposition are divided. In each, prophecies, charms, enchantments, giants, dwarfs, witches, are called in to supply the marvellous; in each, amorous and ludicrous adventures are employed to relieve the solemnity of the main body of the fiction; in each, we find a crowd of minor characters and incidents diverging in all directions from the great centre, yet all in some way or other attesting their connection with it. What Charlemagne is to his peers, the romance of Charlemagne is to its age; and exactly so as to Arthur, and the body of fictions of which his round table is the centre point.

In both of these classes of romance, reference to historical authority is continually and ostentatiously made. In a great measure, the incidents of which they treat are to be found sketched in the chronicles, or pretended chronicles, of Turpin on the one hand, and of Geoffrey of Monmouth and his compeers on the other. There seems, however, to be no reason to doubt that the compilers of these chronicles had embodied in them the materials used by the original bards of Britain and Armorica, and minstrels of Normandy. Charlemagne, for instance, is personally represented throughout as a character very different from what he was in real history; as a rather indolent and good-natured old man, harassed by the conflicting claims and pretensions of a set of too powerful vassals. This is very much the view of the matter, which we might imagine likely to be taken among the original Norman invaders of Neustria;—such having been in fact the situation in which they, for their own luck, found the French monarchy. But it is not the view of the matter natural to persons in any other situation.

Oldest English metrical romances and translations.

The earliest romances of both classes now in existence are, as has been observed above, *metrical*; and the oldest English metrical romances are professedly translated from the French, unless one exception be found in the *Sir Tristram* of Thomas of Ercildoun, which has been so ably edited of late years by Sir Walter Scott. According to that learned author's hypothesis, Thomas the Rhymer lived and composed early in the thirteenth century, close to the boundary of the old British kingdom of Strath-Clyde, which had no doubt preserved entire for a long time the original legends of that scattered and humbled people. And indeed it is to be kept in mind, that the sites of many of the places and events most illustrious in the Arthurean romances are in the northern parts of the island. The great capital is Caerleol, (Carlisle). Galloway is supposed to have taken its name from Sir Gawain. Berwick was the *guarde joyeuse*, the residence of Launcelot; and the tomb of the faithless Queen Guenever is still pointed out by the country people at Meigle, in Angus. This part of Sir Walter Scott's essay on Tristram must be consulted by every one who wishes to understand the subject; as also Mr. Ellis's preface to his *Specimens of the Ancient English Metrical Romances*, where the hypothesis first started by Sir Walter is adopted, and strenuously enforced.

Sir Tristram an exception.

Robert Wace, &c.

According to the opinion of the best writers, the earliest French metrical romance about Arthur, as yet discovered, is *Le Brut*, the work of Robert Wace, a native of Jersey, written in 1155, and founded on the chronicle of Geoffrey of Monmouth. For analyses of this and of the *Chevalier au Lyon*, attributed by most antiquaries to the same author, as also of the various romances of *The Sangreal*, *Percival*, &c. composed during the two next centuries by Chretien de Troyes, Menessier, and others, we must content ourselves with referring to the works of M. Legrand, M. Tressan, &c. among the French. Many interesting particulars concerning them may also be found in the English works of Ellis and Ritson, and in the more recent history of fiction by Mr. John Dunlop.

Huon de Bourdeaux, &c.

The oldest metrical romances of the Charlemagne class are likewise in French. It is not easy to fix their dates; but *Huon de Bourdeaux*, (the foundation of the charming poem of *Oberon* by Wieland,) is generally supposed to be the oldest of them; and the romance of *Fierabras*, which king Robert Bruce delighted to read to his companions, seems also to be among the earliest. It would be in vain to attempt even an enumeration of these works. Mr. Ellis has furnished us with admirable analyses and abundant specimens of the English translations and imitations of them, executed when the use of the French language had begun to give way in this country.

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* The *Langue d'Oil* was the dialect of northern France, in contradistinction to the *Langue d'Oc*, that of the southern province still so called. These dialects were so named, from the circumstance that in the one of them, when the Roman tongue became corrupted, the affirmative *aio* (some say *utique*) was retained under the form of *oil*, afterwards *oui*; while in the other, *hoc*, (this, nothing but this,) was preserved under the form of *oc*. *Sic*, shortened to *si*, gave in like manner a distinctive name to the vulgar dialect of Italy herself. Hence Dante's *Il bel Paese la doue il si se Suona.*

Metrical romances founded on classical history.

About the same time various metrical romances were composed in French, and imitated both in German and English, in which the old Greek heroes once more make their appearance. The composers of these followed the same plan as those of the proper Gothic romances; that is, they took their materials from monkish chronicles of the Trojan and Macedonian wars written in Latin. The constant habit of representing the actual manners of the writer's own time being adhered to, these romances, though professing to detail the events of periods so remote, are in fact quite, or nearly as valuable, to the student of our own Gothic antiquities, as any others. Achilles is no more than a *preux chevalier*, and Alexander the Great is merely another shadow of Charlemagne or Arthur. Troy, Babylon, &c. are only so many disguises for Palestine. The theme is always the success of European arms in expeditions to the east.

The expeditions of the crusaders, however, were celebrated by other romances of their own age in a more direct manner. Richard Cœur-de-Lion, Godfrey of Bouillon, &c. shared the favour of both bards and historians with the Rolands and Olivers, whose real or fancied achievements had kindled their own imaginations, and whom, it must be admitted, they imitated in many particulars with wonderful success.

By whom composed.

The question by whom, or rather by what set of men these metrical romances were composed, has been made the subject of much and angry controversy; some contending that they were always the work of the minstrels, who, we know, wandered from abbey to abbey, and from castle to castle, singing or reciting them for the amusement of the company there assembled; others, with equal confidence and pertinacity, maintaining that the works so dear to them, bear marks of art and refinement altogether above what could be expected in the compositions of an order of men, whom it pleases them to consider as low-bred, profligate, and vagrants, in all but the most offensive modern meaning of that term. Here, as elsewhere, it appears to us that both sides are in the right and both in the wrong. The former party, at the head of whom is Percy, the excellent Bishop of Dromore, forget, or seems to forget, that with whomsoever any species of composition originates, it is always sure to be taken up and imitated by others the moment its popularity is ascertained;—and that therefore we may be all but certain, that the ecclesiastics in whom the information and learning of those times mostly resided, and who, as their own story shows, were fond of hearing romances recited, must have indulged themselves in the compositions of other fictions of the same class. This was the popular literature of the time, and that is always in the hands of the most literary persons of the time. The other party again, and particularly the venomous Ritson their chief, talk far too slightingly of the minstrels. We find that men of that class obtained large grants of land, both in England and Normandy, under the early Plantagenets; and we also know, from the authorities produced by Sir Walter Scott in his Tristram, that they were in many instances treated after the same liberal fashion in Scotland. Their profession admitted originally, like most others, of various degrees of excellence and of honour within its bound; and it is ridiculous to suppose, that the degraded condition to which it had sunk, when it was found necessary to suppress it altogether by statute in the reign of Queen Elizabeth, affords any evidence whatever as to the character and manners of its members in those earlier days, when, as there was scarcely such a thing as a reading baron, the most intellectual amusement of the highest classes of society depended on the exertions of the visitors, who sung, or said, the legends of romance in their halls. Wace was a dignified ecclesiastic;—Thomas of Erceldoun was a gentleman of family and fortune;—yet why should we strive to limit the claims of genius in a much humbler class of life, we who have in our time seen so much poetical genius spring up and command the attention of the world from the very bosom of our peasantry?

The metrical romances were gradually converted into prose ones in the course of the two or three following centuries. This was the natural course of things. Taste for this kind of fiction growing, the form of composition in which it was the most fully and elaborately brought out, gained favour, and the rhymes of the old minstrels, by whomsoever written, gave place to longer and much more artificial tales in prose;—to those romantic histories, in short, of Merlin, Arthur, Tristan and Yseult, Ysaie le Triste, Gyron Le Courtois, Perceforest, Meliadus, Guerin de Monglave, Gallien Rhetore, Ogier le Danois, Dolin de Mayence, and the other works of the same order, which are all of them fully described by the modern authors already referred to, and from which unquestionably one of the most fruitful and interesting species of modern European literature has been derived, through but one or two easy gradations of descent.

The French prose romance of chivalry began to decline in popularity from the time when Lobeira* the Portuguese, (who lived in the fourteenth century) composed the first four books of Amadis de Gaul. This formed the commencement of an altogether new series of chivalrous romances. The adventures of Amadis himself were so extended by imitators of the original author, as to fill twenty-five books; and Palmerin of England, Esplandean, Florismond of Greece, Belianis, and a variety of other works all grew out of the same new field of fiction. Lobeira had the merit of introducing a regularity of plan and purpose altogether unknown to his Norman predecessors; he enriched his web of fiction by a more skilful exposition and contrast of character: he gave far more dramatic truth to his interlocutors, and finally he composed in a style infinitely more artificial and elegant. His great work, therefore, obtained an easy victory over the prose tales of Arthur and Charlemagne, and some of his imitators were not unworthy of partaking his triumph. But it must be confessed that his school was upon the whole a miserable one, and that the continual accumulation of inferior stories of the Amadis race had become a real nuisance, more especially in Spain, long before Cervantes appeared to put an end to it by his irresistible satire.

The first essential distinction between the romances of this class and their predecessors is, that the heroes of the Amadisian cycle are altogether imaginary personages: the second is, that in these works the attention is always fixed upon the fortunes of some one hero or heroine. We are no longer occupied with national events, or with national feelings, but with the exploits and adventures of individual knights. This was an important step in the history of romantic fiction. It marks the transition to another state of society. The great collisions between peoples of different races contending for country and faith had passed over; and romance, following the stream, betook herself to the influence of the spirit of chivalry upon private knights—their wild and wavering adventures—their restless life—their tournaments, duels, and other mockeries of war.

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* We give this name without hesitation: for we consider the controversy as to the authorship of Amadis to have been quite settled by Mr. Southey.

Another species of fictitious writing sprung up also in Spain, under the name of the pastoral romance. George de Montemayor, a man of great talents, first gave vogue to this kind of writing by his *Diana*, a work which was long most extensively popular, and from an episode in which, Shakespeare has taken the story of his *Two Gentlemen of Verona*. Cervantes laughed at the absurdities of Montemayor's disciples; but his own first romance, the *Galatea*, was after all a production of the very same school. The wearisome languors of the Arcadian existence depicted in the works of this brood, their piping sentimental shepherds, and crook-bearing heroines; their *fade* and unmanly tone, were radical and ineradicable absurdities, and not even the names of Montemayor, Cervantes, and our own Sir Philip Sidney, have been able to keep their productions of this class from total neglect—all but total oblivion.

We may dispatch in as few words the heroic romance as it was called of the seventeenth century. This was begun by Honorè D'Urfè, a fantastic character, who wished to shadow out some adventures of his own family under a stately disguise of remote manners. He was much obliged to the unreadable love romances of the later Greeks, but on the whole his colouring is the reflection of the romance of chivalry. He was followed by Madame Scuderi and other writers of considerable talent, who in vain endeavoured to give life to a species of composition radically absurd. Nevertheless the melancholy metaphysics of this school of amorous fiction, its ridiculously overstrained sentimentality, its pompous affectations of all sorts, found favour for a time; the enormous folios in which these follies were embodied, continued to infest the taste of the reading public until the nature and sense of the modern novel appeared, and gave them the coup-de-grace.

But before we enter upon the consideration of the existing literature of romance, we must say a few words in regard to some other elements which were mingled in its original formation with the general form (however improved and refined) and with not a little also of the spirit of the genuine old European romance. All down through the ages in which those old romances were composed and admired, there was another and a totally distinct species of fictitious narrative in which our ancestors found sources of amusement and delight, generally speaking, of a lighter and more comic character. It is not easy to say what were originally the precise limits of the proper *Roman*, the *fabliau*, and the *lai*. By many critics of great name it is supposed that *lai* was originally the name given to compositions in verse borrowed by the Romans from the people of Bretagne—in other words, of Celtic origin; and they go on to state their opinion that the proper *Roman* differed from the *Fabliau* only in being of greater length, and turning on incidents of a more serious cast. We have no room for discussing these controversies here, but it is certain that the Norman *Trouveurs* had a body of light ludicrous poetry from a very early period, and that, whatever hands the fictions of this class may have passed through, they may in far the greatest proportion be traced to an oriental original. The collection of tales by Petrus Alphonsus, the collection entitled *Gesta Romanorum*, the famous legend of the *Seven Wise Masters*, were obviously among the readiest and most used sources whence the trouveurs took their materials, and a very great part of these materials has been already traced to the ancient literature of Persia, and the yet more ancient literature of India.

Boccaccio, &c.

The corresponding class of men in southern France, the *troubadours*, produced but few *fabliaux*; they betook themselves almost exclusively to the poetry of sentimental and metaphysical love. Each of these classes of poets have produced a powerful influence on European literature, but their influence has not been equally acknowledged by those indebted to them. Petrarch and Dante gloried in confessing their obligations to the troubadour poets of Languedoc and Provence; but Boccaccio and his followers, the classical novelists of Italy, have preserved silence as to their not inferior obligations to the fictions of the *trouveurs*. The apologues, merry tales, satirical anecdotes, witty turns, comic satires, and ludicrous love-stories of the Fabliaux, were transformed into the elegant *novelli* of the old Florentines. From them they passed into European literature at large, under a shape of refinement which secured them lasting popularity; and, in a word, it is not quite easy to say whether the drama and romance of Spain and of England be more indebted to the Italian novelists for humorous incidents, or to the old romance of the middle ages for elements of a higher description.

Cervantes.

Cervantes was the great genius for whom it was reserved to mould out of the admixture of these various elements of fiction, that species of composition, the possession of which may be said to form one of the chief distinctions of modern literature in general as compared with the literature of classical antiquity. He tried them separately ere he hit upon the happy idea which has immortalized him. He imitated the tales of Boccaccio and the Diana of Montemayor, and he at one time certainly had entertained thoughts of writing a serious imitation of Amadis.* But Don Quixote was the felicitous conception destined to form a new era in European letters.

The Spaniards had, before this work appeared, divided their favour between the brood of Amadis on the one hand, and on the other comic satirical tales, formed no doubt from the Italian novels, but composed at greater length, turning almost exclusively on the tricks of cheats, sharpers, and vagrants—the tales of what they called the *gusto piscaresco*—of which Lazarillo de Tormes, and Guzman D'Alfarache are the best, and the best known. In these works the base side of nature was caricatured as exclusively as the lofty one was exaggerated in the proper romances. Cervantes conceived a plan by which he was enabled to unite all the best elements of both, and to give both the benefit of being illustrated by the power of contrast. How far he was himself aware of the extent to which he was about to change the whole face of romantic literature, it is hard to say, for no great man was more modest than he, not even his contemporary Shakespeare. The result, however, is, that we have a species of literature which the world had never had before, and which appears to have a fair chance of ultimately holding a rank not inferior to that of the drama itself—the prose epic of actual life—a form of composition which opens the widest field imaginative genius has ever been engaged upon; which admits the use of materials of at least as diverse character, and is capable of rewarding the exertions of talents at least as various as the stage; and which permits manners, feelings, characters, incidents,—above all, the developement of individual natures, and the picturesque of manners,—to be represented in a style infinitely more full, satisfactory, and complete, than any other mode of composition with which the world has ever been acquainted.

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* This is certainly the fact, if the Canon of Toledo in Don Quixote be intended, as few can doubt he is, to speak the critical sentiments of Cervantes himself.

Don Quixote.

It would be ridiculous to enter into a particular description of a work so perfectly known to all who read any thing, as this; we shall only observe, *first*, that it is a total mistake to suppose that Cervantes intended to attack the spirit of heroism; on the contrary, in Don Quixote himself, he is careful to make us revere the high feelings of the Castilian gentleman, even while we are smiling at the extravagancies of the madman. It is equally wrong to suppose that he attacked the real old stately romance of the middle ages: on the contrary, he had at one time an intention to write a solemn romance of that sort himself; and throughout all his books we have distinct laudations of Amadis and Palmerin, and the truly excellent romances. He caricatured indeed some of the incidents of the original Amadis, because they were universally familiar to his readers, but his true object (and he himself says so in his preface) was to put down the taste for the bad imitations of Amadis with which Spain was at that time actually deluged. His happy genius rendered him incapable of executing this without doing things infinitely better. He could not ridicule those trashy romances, without producing a true romance himself—a romance in which the ludicrous and the pathetic, the satirical and the poetical, the fulness of narrative, and the clearness and terseness of dramatic composition, were all for the first time blended together,—each element gaining life and beauty from the contrasts under which it is surveyed.

Direct imitations of Quixote.

This masterpiece has been imitated in the most close and direct manner by many, and some of these works so composed, with the avowed purpose of laughing down particular absurdities in the same way in which Cervantes had exploded the romances of knight errantry, are by no means destitute of merit and interest. The English *Spiritual Quixote*, in which, the enthusiasm and folly of the first itinerant Methodist preachers was attacked; the *Sylvio de Rosalva* of Wieland, directed against the mania for *Fairy Tales* which prevailed in those days in Germany; *The Heroine*, a laughable satire upon modern novel readers, by the late Mr. Barrett; and a crowd of other works of the same order might be mentioned. By far the ablest and best of them all, however, is scarcely known in this country even by name—the *Don Gerundio* of the Spanish Jesuit Ysla, a work written with the view of ridiculing the various tricks of the Mendicant Friars, who still infest every quarter of the Peninsula. The author being a man of true genius, has done much more than his plan might seem to suggest—so much that in its own country the Don Gerundio has come to be generally talked of as the Quixote of Letters.

Don Gerundio, &c.

But the influence of Cervantes has extended very far beyond all this. He had set the example of representing men and manners in a totally new style—a style not essentially less captivating than that of the drama, and admitting of a fulness of detail and execution far beyond the limits of works intended for stage-representation. His work, though designed for a main comic purpose, contains, within itself, abundant specimens of serious eloquence, and profound pathos, and, written to ridicule one kind of romance, overflows with every element of romantic interest, the loftiness of sentiment, and the picturesque of nature. In a word, it may be doubted whether any one specimen of fictitious narrative in prose, has since that time commanded real lasting success in any European country, the author of which has not been in a high degree indebted to the Cervantic model. The whole race of our modern novel and romance writers are his imitators, in the just but liberal sense of that term. He has taught every thing to those whose genius was exclusively comic; and to those whose turn of mind and purpose of writing are the most opposed to the comic—to the most ardent lovers of the tragic, the marvellous, the sentimental, the passionate, he still continues to teach the great lesson of controlling, the extravagances of enthusiasm. It was he who revealed the secret of throwing an air of truth and reality even over the wildest dreams of imagination.

It is true that Xenophon, in his Cyropædia, set the first example of attempting to attain a particular philosophical purpose through the means of narrating the life of a particular individual. But, to say nothing of the important circumstance that after all Cyrus was a real personage, and that we do not know how much, or how little, of Xenophon's materials falls within the proper limits of fiction, the tameness and total want of dramatic power of his work are too obvious to be denied by any one. He was not a man of sufficient genius to do a thing that had not been done before, so well as to make that often be done again. It is doubtful whether Cervantes knew Xenophon at all. It is certain that if the elegant Greek modelled a coldly pleasing statue, he was the true Prometheus who breathed the breath of life into it.

The truth is, that refined as the arts of Greece were, the Greek nation was never in such a state of refinement as to admit of this kind of composition becoming an effectual instrument of delight and instruction among them. The drama was their romance. Their imagination was more lively than their. curiosity was profound, and they preferred the visible representation of a part to the complete exposition of a whole. In a word, they were not a reading population; and we hold it to be equally clear, that a species of composition, such as, the modern fictitious narrative of Europe, could never have become extensively popular among any people, unless reading had come to be most extensively the amusement of that people;. in other words, we consider this species of literature as incapable of existing, unless among nations far more thoroughly educated and refined than any of the nations of classical antiquity could have been. "The drama," says Goethe, in his *Wilhelm Meister*, "has characters and deeds—the field of romance is incident, feeling, and manners." The Greeks were (when their literature flourished) a young people; they were almost ignorant of peace; their proper heroic poetry was so unrivalled in excellence,—and its heroes were, comparatively speaking, so near to them; and their drama was so admirably calculated to satisfy all the wishes of a clever people, who, as a people, could not read;—that it is any thing but wonderful they should have left at least one great department of imaginative literature to be opened and cultivated by the moderns. Their domestic manners, moreover, were always barbarous—the hearth had with them but a narrow circle.—What wonder that they should have clung exclusively to the literature of character and of action, as contradistinguished from that of sentiment and feeling? Lastly, they knew no manners but their own, therefore, they did not understand their own manners. Upon what other principle can we account for the real ignorance of their domestic life, under which, with so much of their beautiful literature before us, we unquestionably feel ourselves to be left, unless upon the very same principle which we have mentioned as accounting for their having no literature of the kind we are now discussing; none, at least, that can be talked of as worthy of their genius—none that has, in point of fact, been found worthy or capable of commanding our elsewhere willing imitation?

It does not, we must confess, appear to us, that this matter has ever, in any of its really essential points, obtained any thing like the attention to which it is entitled. Above all, it does not appear to us, that the philosophical criticism of modern Europe has been in any effectual manner directed to the consideration of a fact, which one might have supposed to be of a nature sufficiently distinct and obvious, as well as important—the fact, namely, that to all intents and purposes the literature of romance has supplanted, in modern Europe, the literature of the drama. Lope de Vega was the contemporary of Cervantes; and Calderon flourished immediately after him. Lope was a greater man in his own day than Cervantes, and Calderon was as great a one in his: but what are their plays to Spain now? What have they been to Spain, compared with the author of Don Quixote? What characters of theirs are known at all, when compared with his? Are their books, or have they been, like his, the staple food of the Spanish mind? It is absolutely impossible that if they had been so, they should have remained so completely unknown out of Spain as they have done. Looking to England, again, Shakespeare was exactly contemporary with Cervantes; he alone created the drama of England—did not that drama also (to all serious intents and purposes,) terminate with him? Is it not the fact that the genius exerted on our drama, subsequent to his time, is totally unworthy of being named in the same day with the genius exerted on our romance, since the masterpiece of Cervantes was made known amongst us? Is it not the fact, that but few even of Shakespeare's plays are in possession of the British stage? Is it not the fact, that the stage has ceased to be to any extent worth mentioning an entertainment of the more refined classes of British society? Is it not the fact, that Shakespeare is studied and enjoyed by us in the closet?—Is it not a fact, that Lear and Macbeth are read rather than seen?—In France the play-house is more popular than with us—the French are a more frivolous people than we; and are more easy to be pleased as to amusements. But what has been the case as to the real talent of France? What has been the course of her literature? Their drama has certainly made no progress since the time of Louis XIV.—their imaginative literature has been the literature of romance, not of the drama. What are all their comedies subsequent to Moliere, compared with a single volume of Le Sage? What literature has exerted that sort of influence over them which the Greek drama did over the old Greeks?—Not their drama certainly—but their exquisite romances. Rousseau's Emilius, Voltaire's Candide, Madame de Stael's Delphine and Corinne—what plays of the last century can they compare as to real influence with such works as these? Germany is the only other country worth mentioning. Her modern imaginative literature, however, is essentially nothing but an imitation of the literature of England, of recent growth too, and grown among a nation highly refined and educated ere it began to appear among them. Their stage, in particular, is a mere child of ours, and so is their romance. In spite of all the exertions of courts and patrons, what has been the fate of these? Have not Werther and William Meister produced ten times more effect in Germany, than the dramatic works of Goethe?—excepting, perhaps, the Faustus, which is a dramatic poem, not a drama. And is not the only tragedy of Schiller's that can be said to sustain his fame in the altitude for which his genius was born—his Wallenstein—is not that tragedy a complete romance, thrown merely into a dramatic form? A tragedy in three long plays; a complete history, in the form of scenes! The drama has been found incapable of contending in the great race of influence with the romance. The latter species of composition has almost supplanted the former, even among the nations richest in them both. And why? It is a species of literature, the peculiar growth of the modern mind, and peculiarly calculated to keep pace with that mind, by turns leading and led, reflected and reflecting.

Modern romantic literature.

The very popularity of this new literature will form the best of all apologies for not detaining our readers with much farther disquisition upon it here. What readers are not as well acquainted as we can be with Le Sage, Rousseau, Mariveaux, Marmontel, De Stael, De Foe, Richardson, Fielding, Smollett, Sterne, Goldsmith, Radcliffe, &c. at least with those works of theirs which deserve to be placed in the first class of romantic literature?

Its comprehensive character.

The first thing that must strike every one, considering the matter in a broad light, is the extraordinary range which this species of literature opens for the exertion of talent. What beings can we conceive of, as more diametrically opposed to each other than almost any two that could be selected even from the small number of names we have just been repeating? What is that peculiar vein of thought, what is that variety of passion, what is that field of manners, what that sphere of philosophical purpose, what that satire, what that sentiment, that may not find its easy and adequate representation within this earth-wide walk?

Its variety.

Perhaps the very greatest charm of this form of composition, is the facility with which it permits the most various elements of interest to be blended and interfused together within one work; and perhaps the very best of its productions are those, in which the greatest variety of these elements are found in combination. The very first romance writers have indeed been men of that highest order of intellect, which excludes the notion of the possessor being distinguished by the greatness of one class of his powers alone. The very greatest have been both wise men and wits, both poets and orators, both humorists and satirists, great both in the conception and development of character, great in dialogue, in narrative, and in reflection. The greatest of them, however, have as certainly exerted these variety of powers, under the guidance of some one leading aim and purpose. The free and unfettered character of the form of composition, has, in other words, allowed and encouraged each individual mind to stamp upon it the broad and indelible traces of its own favourite energies. Here genius paints full lengths of itself, as well as of its creations. Who does not feel as if the elegant wit of Fielding, the irresistible humour and sarcasm of Smollett, the precise hair-pencil description of Richardson, the capricious flights of Sterne, the sharp and all but demoniacal satire of Le Sage, the profound pathos of Goethe, the easy gentlemanlike humour (to mention nothing else at present) of the author of Waverley—who does not feel as if these had been the most distinguishing elements of the fireside conversation of some of his own most intimate associates?

Its real and distinctive excellence.

No mode of composition was ever invented, in which it is so easy to lay bare the inmost mysteries of the nature of man; and for that reason, the nature of man becoming the favourite object of attention exactly in proportion as civilization is extended, we have no hesitation in expressing our opinion, that this branch of imaginative literature has the fairest prospect of continuing to be, as it unquestionably has been during the last century, the most popular and successful of all.

Romance or novel.

A distinguished contemporary, (alluded to at the beginning of this paper) seems to consider the novel and the romance as forming two essentially distinct classes of modern literature, drawing his distinction from the presence or absence of the marvellous. We have already ventured to express our dissent from this view of the matter; but it may be proper to say a few words more on the subject ere we close our article.

To us, then, it seems that, from the date of Cervantes' masterpiece, the mere marvellous has ceased to form the essential merit, and therefore we cannot consider it as forming the essential distinction, of any successful class of fictitious narrative. From that time actual nature was and is imperatively demanded from every one, who hopes to fix attention on his compositions in this great department of literature; and we venture to doubt, whether even the highest genius could now give any thing more than a mere ephemeral popularity to any lengthened work of fiction, in which possibility should be absolutely set at naught, for any purpose other than a merely satirical one. Gulliver is the only work of first-rate genius of last century, the substratum of which is an actual impossibility; and even there we have only to grant one postulate (a startling one we admit) at the outset, and from that moment we are reading an admirable narrative of actual nature. The day of the castle of Otranto, and of all similar works, is but a short one, and moreover, such works are, even in their own day, admired only as elegant modernizations of the genuine old romance of the middle ages. They have nothing to do with that literature which derives its power and its charm from its expressing the movements of living mind, and the picturesque of real manners.

The marvellous.

It would be totally ridiculous to deny that the *marvellous*, (even taking the term in its strictest sense,) has ceased to be a great element of interest. Superstition is not yet eradicated from the human mind: fear and terror never will be so. Schiller, in his *Ghost-seer*, Radcliffe in her admirable works, Godwin in his *St. Leon*, and some others, have produced a powerful effect by their use of supernatural machinery; but how? only by presupposing, as Swift did in *Gulliver*, the possibility of one or two absurdities, and then proceeding to write a narrative, it is no matter whether one calls it a romance or a novel, of what might have occurred—these preliminaries being granted. The whole charm with them lies in the superstructure of actual feeling and manners. In the old romance the marvellous stood *per se* the grand bauble of a young and unthinking age, totally and radically distinct from the worthy delight of a highly refined, a profoundly curious, and a profoundly reflective state of society.

This literature is the reflection of actual life—that is its essential character and its peculiar merit. Different authors will of course tinge their compositions according to the turn of their own minds; a Defoe will always describe incidents with a more prosaic, yet a more satisfactory fulness than a Sterne; a Godwin will always sound the depths of passion plummet and plummet below the reach of a Fielding; a Fielding again will always represent more of the bright side of human existence than a Smollett, and a Smollett will always paint mere absurdities more strongly than a Fielding; a Rousseau will always skim the surface of manners, and plunge into the world of sentiment. A Cervantes alone, or an Author of Waverley, will have the comprehension and the grasp to unite in his picture, all, or nearly all the elements of human life and sources of human interest.

It is impossible for us to guess to what purposes this branch of literature may be hereafter converted. One remark we may hazard, and this is, that as the external manners of the different nations of Europe as nations, of the different classes of society as classes within each nation, and of the members of each class of society within itself, are daily becoming more closely assimilated, that department of this art which concerns itself with *manners* chiefly, must of necessity be the first exhausted. You may teach men to behave like each other, but you never can teach them to feel and to think so; and there is the really inexhaustible province.

In our own time, no doubt, the painting of mere manners has been considered as forming one of the principal sources of attraction in the most popular works of this kind that have appeared. We attribute this circumstance, however, to mere secondary causes, and to causes which are not likely to operate again: and, besides, we cannot doubt that the best and most lasting charm of the works to which we allude, will be found to consist in elements of a much higher order—in the universal nature of character, and the profound feeling for truth and beauty by which the Author of Waverley is throughout distinguished. To say truth, we think the solemn, formal, and elaborate way in which even that unrivalled writer describes mere manners, is of itself a sufficient proof that the day of such description is near its close—*τεχνη εν [illegible]*. The admirable antiquarian knowledge possessed by this author, and the peculiar circumstances of the country in which he was born, have, in short, enabled him to open and to adorn a field on which we do not apprehend he is likely to have any very successful successors. But there are two higher elements in his fame—his Shakespearian range of character, and his happy expression of the peculiar spirit and tone of thought and sentiment impressed on the character of his own age, so directly the reverse of that of the age immediately preceding; and there are excellencies in which, though we cannot supose it likely he shall ever be surpassed, we yet see no nlikelihood of his being followed with steps less disdvantageous. Romance may always continue to be he mirror of that human nature which is inexhaustible, and depict the spirit of age after age, throughout whatever varieties of thought and feeling it may be the fortune of our race to pass. We see no form of imaginative literature which appears to us so likely to keep pace with the daily increasing luxury, and yet the daily increasing expansion of the modern mind.

Romance.

ROMAN EMPIRE.

The early history of Rome, like that of all other ancient nations, is involved in mystery and fable. When he memory of distant events has been preserved only n poetry, it is difficult to separate the true from the ictitious narrative; and this difficulty is no where greater than in the early history of Rome. If he poet, however, exaggerates and embellishes, and even invents new circumstances, we must not deny he whole narrative as fictitious, because a part of it has existed only in the imagination of the narrator. In uch a case the probability of the events is the only est which we can obtain of their truth; and even if he poet has been careful to stamp this character upon his own creations, we cannot err much in adopting the eading outlines of his story.

When Æneas was driven from his native land by the sack of Troy, he landed in Italy after a variety of wanderings and misfortunes.* He first disembarked at Cape Minerva, in Japygia, and afterwards sailed to Drepanum, n Sicily, where a Trojan colony had already established itself under Elymus, and Ægystus. Either from necessity or choice, or perhaps partly from both, he left behind him at Drepanum several of his followers, and pursuing his course over the Tyrrhenian Sea, he landed in Italy near a cape, to which he gave the name of his faithful pilot Palinurus, who terminated his life and his duties at the same interesting moment. From hence Æneas continued his examination of the Italian coast, till he reached the territory of Latium, situated on the east side of the Tiber, and now forming a part of the Campagna di Roma. The capital of this territory was called Laurentium. It was subject to Latinus, who was then engaged in a war with the Rutuli, and who on that account gave a warmer reception to the helpless strangers, and speedily secured their friendship by a liberal alliance. The character of Æneas and of his followers seem to have inspired the Latins with the highest confidence. Latinus gave Æneas his daughter Lavinia in marriage; and the rest of the Trojans formed matrimonial alliances with Latin families.

These events, however, while they united the houses of Latinus and of Æneas in the closest bonds of friendship, gave rise to a formidable attempt against Latium. Turnus, a relation of the queen, and who had been brought up in the family of Latinus, had conceived an early attachment to Lavinia. Enraged and mortified that a stranger should possess that being on whom he had placed his happiness, he joined the arms of the Rutuli; and in the first battle which took place both Turnus and Latinus fell.

Having thus come into the peaceful possession of the throne, Æneas united the religion of Troy with that of Latium. He introduced the worship of Vesta, and it was probably from him that the Latins derived their knowledge of Jupiter, and many other of the Trojan deities.

Roman Empire.

An alliance between the Rutuli and Mezentius, the king of the Tyrrhenians, again forced Æneas into the field. The hostile armies met near Lavinium, and Æneas, being pressed by superior numbers to the banks of the Numicus, was driven into the river and drowned. Having concealed his body, the Trojans pretended that he had ascended to heaven; and a temple was erected to him under the appellation of Jupiter Indiges.

Death of Æneas.

The Trojan warrior was succeeded by his son Ascanius, or Euryleon, who prudently sought to terminate the war by an honourable peace. Mezentius, however, having demanded too high a tribute, the Latins resolved to try the contingencies of war. The flower of the Tyrrhenian army lay entrenched at the very gates of Lavinium, and was placed under the command of Lausus, the son of Mezentius. The Trojans, accustomed to this species of warfare, made a valorous sally against the besiegers, and having forced the entrenchments under Lausus, drove him to the main body, which was posted in the plain. The terror which was thus struck into the confederated army, incited the Latins to pursue their advantages, by driving the enemy into the fastnesses of the neighbouring mountains. In this pursuit Lausus fell, and Mezentius, disheartened by the loss of his favourite son, sued for peace, and yielded to the principal condition of the Latins, that the Tiber should henceforth be the boundary between the Latin and the Tyrrhenian territories.

Lavinia, who was with child at the death of Æneas, began to entertain an unreasonable dread of Ascanius; and retiring to the woods, was delivered of a son, who received the name of Æneas Sylvius. As soon as Ascanius became acquainted with the retreat of Lavinia, and the cause of her alarm, he treated her with the greatest gentleness, and prevailed upon her to return to Lavinium with her child.

As Æneas Sylvius was the undoubted heir to the throne of Latium, Ascanius cheerfully resigned the sovereignty, and built for himself the town of Alba Longa, where he died after a reign of thirty-eight years, of which he had spent twelve in his new city.

Alba Longa founded. 1152 B. C. Death of Ascanius.

Ascanius left behind him an only son Julius, the undoubted sovereign of Alba Longa. To prevent the risks of a divided kingdom, the Latins agreed to unite both these states under the political sovereignty of *Sylvius*, and to confer upon Julius the sovereign authority in religious affairs.

After the death of Sylvius, who reigned 29 years, his son Æneas Sylvius governed Latium for 31 years; Latinus Sylvius for 51 years; Alba 39; Capetus or Atys 26; Capis 28; Capetus 13; Tiberinus (who gave his name to the Tiber where he was drowned) 41 years; and Alladius 19. His successor Aventinus left his name to the Aventine Hill, where he was buried; and Procus, who reigned after him for 23 years, left the throne to his eldest son Numitor. His younger brother Amulius, however, murdered Ægestus, the only son of Numitor; and, in order to secure the sovereignty, he consecrated Numitor's daughter, Rhea Sylvia, to the worship of Vesta, and to the virginity which that office demanded.

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* See ÆNEAS, ÆNEID, Vol. I. p. 16; ANCHISES, Vol. II.; and HOMER, Vol. XI. p. 97.

Rhea Sylvia.

While the unwilling vestal was fetching water from a neighbouring spring, she was ravished by a person in a military dress; but whether the ravisher was Mars, Amulius, or some lover of her own, she was carefully watched by Amulius till she was delivered of two sons. An assembly of the people condemned Rhea to death, and her offspring to be thrown into the Tiber. The sentence upon Rhea was changed into confinement; but the innocent children were launched upon the Tiber in a wooden trough. Fortune drove their frail bark upon the strand, and its helpless crew were saved by the king's shepherd Faustulus, and carefully suckled by his wife Acca Laurentia.

Birth of Romulus and Remus.

At the age proper for education, Faustulus sent the boys to Gabii, to be instructed in Greek learning. A superiority of mien and of intellect acquired for them a superiority among the other shepherds; and during a quarrel between the herdsmen of Numitor and Amulius, the twins, who had received the name of Romulus and Remus, took the part of the latter. The herdsmen of Numitor seized the earliest opportunity of revenging themselves for the injury which had been done to their party. They surprised Remus at the festival of the Lupercalia, and carried him before Numitor, to receive the punishment which he was thought to have merited. The appearance of the young prisoner inspired Numitor with a deep interest in his fate. He inquired into his early history, and he quickly perceived in the mysterious circumstances of his infancy that Remus was his own grandson.

In order to dissuade Romulus from pursuing the shepherds who had carried off his brother, Faustulus was obliged to disclose the history of his birth. The mingled excitements of ambition and natural affection to which this disclosure gave rise, instantly prompted Romulus to deliver his mother and his grandfather from the tyranny of Amulius. Remus had by this time received the same information respecting his origin from Numitor; and a plan was speedily arranged for assembling the peasantry, and investing the palace of Amulius. Formed into companies of 100 each, and carrying as ensigns the manipuli, or bundles of hay, upon long poles, this army of peasants entered the palace, and having slain the tyrant after a reign of 42 years, they restored Numitor to his throne.

Amulius killed and Numitor restored.

Romulus and Remus found a colony.

With the advice of Numitor, Romulus and Remus resolved to establish a new colony on the lands near the Tiber, where they had been educated. Most of the Trojan families, and the inhabitants of the two small towns of Pallantium and Saturnia, united themselves with Romulus and Remus. The workmen were formed into two detachments, one under Romulus and the other under Remus; but this separation gave rise to two parties, one of whom chose the Aventine, while the other under Romulus fixed upon the Palatine hill, as the most desirable site of the city. Having failed in settling this difference by augury, the two factions had recourse to arms, and, in the contention which ensued, Faustulus was killed, and Remus fell by the hand of his brother.

Death of Remus.

Foundation of Rome.

Thus left at the head of the colony, Romulus resolved to build the city on Mount Palatine, and to distinguish it by his own name. After performing the preparatory ceremonies and sacrifices which the customs of the Etruscans required, Romulus yoked an ox and a cow to a plough, and surrounded Mount Palatine with a square outline, to form the wall of the new city, which was begun on the 21st of April, about the year 753 before Christ.

After the city was finished, it consisted of about 1000 houses irregularly arranged, and the inhabitants were principally employed in the cultivation of the soil. When they were thus sheltered from the weather, their first care was to choose their form of government. Romulus was unanimously elected king, and no sooner had he obtained this high office, than he devoted himself to the formation of laws, and the establishment of good order among his people. Assuming a distinctive habit for himself, he appointed twelve lictors as his body guard, and divided his subjects, who amounted to about 33,000, into curiæ, decuriæ, patricians, plebeians, patrons, clients, &c. He established a senate of 100 patricians; and he formed a guard of 300 youth, for the purpose of fighting either on foot or on horseback. To the senate he gave the power of debating and resolving upon measures proposed by the king; and to the people he gave the power of electing magistrates, enacting laws, and resolving upon any war which might be proposed by the king. Of the religious affairs of his kingdom he was equally careful, electing priests, establishing festivals, and constructing a regular system of religion.

The scarcity of females in the new colony, induced Romulus to resort to violence for recruiting this branch of his population. By the advice of Numitor, and the consent of the senate, he proclaimed a solemn feast and public games in honour of Neptune Equestris, which were notified in all the neighbouring towns. The splendid preparations which were made for that celebration, attracted to Rome the Cæninenses, the Crustumini, the Antemnates, and the whole nation of the Sabines, with their wives and children. The strangers were every where received with the warmest civility. But when the shows began, a signal was given, and the Roman youth seized and hurried off about 700 of their female visitors, the most beautiful of whom were carried to the houses of the principal senators.

Although the Sabine women were soon reconciled to their husbands, yet their fathers resolved to have revenge for that breach of hospitality which they had experienced. The injured nations under Acron, king of Cænina, invaded Rome; but Romulus succeeded in defeating the armies which were successively brought against him, and in adding to his own population the inhabitants of the conquered districts. By this accession of inhabitants, it became necessary to add the hill Saturnius to the city, and the citadel which was erected upon it was placed under the charge of Tarpeius.

Although several of the Etruscan states had voluntarily submitted to the Roman power, yet the Sabines, undismayed at their success, demanded the restitution of their women, and when the request was refused, they marched to Rome with an army of 25,000 foot and 1000 horse under the command of their king, Titus Tatius. Romulus took the field with 20,000 foot and 800 horse, and fortifying himself in an advantageous position, would probably have driven back the Sabines, had not the treachery of Tarpeia, the governor of the citadel's daughter, betrayed this important position into the hands of the Sabines. Entrenched in this stronghold they defied for a while the power of Romulus. They were defeated, however, in a general engagement, and driven back into the citadel; but the

Romans in attempting to retake this post, was assailed from the top of the hill with huge stones, one of which wounded Romulus on the head, and were pursued with great loss to the very gates of Rome. The king, however, having quickly recovered from the blow, rallied his retreating forces, and drove the Sabines back into the citadel. In this crisis of danger the Sabine women, who had been carried off, marched in a body to the camp of their countrymen, and pleaded the cause of their husbands with such sincerity and force, that an union was instantly effected between the contending nations.

The conditions of this treaty were highly favourable to both parties. It was stipulated that the two kings should reside and reign jointly at Rome; that the name of Quirites, peculiar to the Sabines, should be taken by the Romans, while the city should preserve the name of Rome, and the Sabines enjoy all the privileges of Roman citizens. Peculiar marks of distinction were conferred on the Sabine women; and their children were allowed to wear decorations and garments to distinguish them from the rest of the people.

During the joint reign of Tatius and Romulus, the city of Cameria was reduced, and 4000 of the Camerini transplanted to Rome. An affray, however, unluckily arose between the kinsmen of Tatius and the Laurentian ambassadors, and when the king went to an annual sacrifice at Lavinium, the populace rose and put him to death. The Laurentians delivered up the assassins, but Romulus did not think it prudent to inflict upon them any punishment, and he contented himself with renewing the treaty between Rome and Lavinium.

The progressive increase of the Roman state induced the inhabitants of Fidenæ to disturb its tranquillity. A number of young men suddenly ravaged the country between Fidenæ and Rome. Romulus lost no time in repelling this unlooked-for assault. He encamped his army about a mile from Fidenæ, and by a skilful ambuscade, with which he deceived the Fidenates, he routed their army and pursued them into the heart of their capital. Having added the country of the Fidenates to his empire, the Veientes, dreading a similar fate, endeavoured to avert it by force of arms. Romulus drew up his army to meet them, and after an obstinate engagement he drove them within the walls of Veii, and forced them to sue for peace. Seven small towns on the Tiber, the salt pits near the mouth of the river, and fifty hostages, were the results of this short campaign.

Being thus freed from all opposition on the part of the neighbouring states, Romulus devoted the rest of his life to the improvement of the laws. He is said, however, to have conducted himself in such an arbitrary manner that the senate, whose rights he had usurped, resolved to destroy him, and accomplished their purpose during a review of his troops, when a violent storm had dispersed the army and left him in the hands of the senators. The body of Romulus was never seen; and it was found necessary to impose upon the soldiers the easy belief, that the violence of the tempest had carried up their divine sovereign and placed him among the gods.

During the interregnum which followed the death of Romulus, the senate governed the kingdom; but, as all parties wished to be under the rule of a king, it was agreed that he should be a Sabine by birth, and that the Romans should make the election.

Numa Pompilius, who had married Tatia the late king's daughter, was unanimously chosen. Devoted to philosophy and the superstition of the times, he employed himself in cherishing the arts of peace. He promoted agriculture, reformed the calendar, divided the citizens into distinct trades, erected temples, and regulated the religious condition of the kingdom.

Tullus Hostilius.
670 B. C.

After a reign of forty-three years, he was succeeded by Tullus Hostilius, whose impetuous temper proved a striking contrast to that of Numa. A system of mutual plunder having been for some time carried on among the Roman and Alban peasants, a war ensued between the two nations. The Albans pitched their tents about five miles from Rome; but feeling that they were descended from the same stock, the contending armies seemed unwilling to fight. Cœlius, the Alban general, having been found dead in his tent, Mettius Fuffetius was chosen his successor. Intelligence, however, having arrived that the Veientes and Fidenates intended to attack the Romans and Albans after they had been weakened by battle, Fuffetius sent a herald to Tullus and decided upon the settlement of their differences by single combat.

Combat of the Horatii and Curiatii.
663 B. C.

In the Roman army there were three brothers born at one birth, called the Horatii, and in the Alban army there were other three also born at one birth, called the Curiatii. The rival armies agreed to submit their cause to the martial decision of these two families, and a treaty was formally ratified by which that nation whose representative champions came off victorious, should peacefully reign over the other. The arena of the combat lay between the marshalled hosts of the Romans and Albans. The combatants took their station in the midst of the hopes and anxieties of their countrymen, and the glittering of their burnished swords and the clashing of their arms indicated the commencement of that fatal encounter. Three of the Albans were soon wounded, and two of the Romans having fallen dead beneath their blows, the surviving, but unhurt Roman, was soon surrounded by the three wounded Curiatii. Unable to contend with three antagonists, the Roman immediately retreated, and was followed at unequal distances by the three wounded Curiatii. No sooner did he perceive that he had succeeded in separating his enemies, than he turned round upon the nearest, and having slain him at one blow, he flew to encounter the second, whom he dispatched before the third could come to his assistance. The joyful shouts which had so lately resounded from among the Alban legions, were now transferred to the Roman line. The wounded and dispirited Alban became an easy prey to the victorious Roman, and yielded up with his life the sovereignty of Alba.

Tullus conquers the Fidenates.

The treachery of the Fidenates in the late war, and their unwillingness to atone for it, called forth the hostility of Tullus. Aided by the Veientes they drew out their forces, and Tullus, availing himself of the Alban army under Fuffetius, made preparations for a general engagement. The Alban general, however, resolving to side with the conqueror, withdrew his army to an eminence; but no sooner did Tullus perceive this than he pretended that this post was occupied by his allies, so that his own army, unacquainted with the defection of their allies, obtained a victory over the Fidenates. After consulting the senate respecting this act of treachery, he sent Horatius to demolish Alba, and commanded the Roman and Alban armies to attend him unarmed. The Romans, however, had their swords concealed, and when the treachery of Fuffetius was explained to the assembled troops, Death of Tullus. B. C. 670.

he was ordered to be torn in pieces by horses, his accomplices were put to the sword, and the inhabitants of Alba transported to Rome. After reducing the Fidenates, Tullus sunk into indolence and superstition. Having reigned 33 years, he and his whole family were either killed by lightning, or by the hands of Ancus Martius, the grandson of Numa, who succeeded him on the throne.

Ancus Martius. B. C. 638.

The peaceful pursuits with which Ancus Martius began his reign induced the Latins to invade Rome. This attempt, however, was crushed by the activity of the king; and defeating the Latins in a pitched battle, he vanquished the Fidenates, Veientes, and Sabines. After building the port of Ostia, and adding Mount Janiculum to the city, he died in the 24th year of his reign.

Tarquin assumes the sovereignty. B. C. 609.

The two children of Ancus Martius having been put under the care of one Tarquin, an opulent merchant from Corinth, who had risen to the rank of patrician and senator, he ventured to assume the sovereignty. After conquering the Latins and the Hetrurians, he devoted himself to the arts of peace. He built the walls of Rome with hewn stone; he constructed the cloacæ, those immense common sewers which have been the wonder of succeeding ages; and he erected the circus and the capitol. The sons of Ancus Martius assassinated him in his palace, in the 80th year of his age; but his wife Tanaquil, having spread the report that the king was only stunned, the sons of Ancus fled, and Servius Tullius, the son-in-law of Tanaquil, pretended to supply the place of the sovereign. When the royal deputy had acquired the respect of the people, the death of Tarquin was promulgated, and Tullius was chosen his successor. After vanquishing the Hetrurians, the new sovereign began to enlarge and beautify the city. He added to it the Esquiline and Viminal Hills, and built a palace on the former. He divided the Roman state into distinct tribes, with a *pagus* or village in each. He relieved the poor from public burthens, and increased the power of the rich. He divided the population into six classes. He gave freedom to the slaves; and finally abridged the regal power.

Death of Tarquin.

Servius Tullius succeeds to the throne. B. C. 576.

B. C. 566.

The age and services of Tullius did not protect him from the ambitious views of his son-in-law Tarquin, to whom he had given his daughter Tullia in marriage. The younger Tullia, who had married Arunx the brother of Tarquin, formed the scheme of murdering her husband and her sister, and of thus acquiring the hand of Tarquin. After paving the way to this incestuous marriage by the help of poison, their union was effected with the consent of the king; but their ambition did not stop here. Tarquin laid claim to the crown itself, and after several unsuccessful attempts to attain it through the medium of the people, he tried to take it by storm, and appropriate the name and the functions of royalty. He entered the temple and the senate, and seated himself upon the throne. Servius having arrived at this conjuncture, ascended the steps, but was immediately precipitated by his son-in-law into the forum. Assassins were sent to complete the murder, and the unnatural Tullia, in her eagerness to salute her husband as king, is said to have driven the wheels of her chariot over the mangled body of her father.

Tarquin obtains the throne. B. C. 529.

The means by which Tarquin obtained the throne held out no favourable prospects of his future conduct. He abolished the salutary regulations of Servius. He banished the nobles who were most distinguished by their virtues, and he seized the estates of those who were more wealthy. The tyranny which he exercised at home, was equalled only by the treachery and bad faith with which he treated his enemies. He subdued the Volsci and the Gabii by the most dishonourable expedients; and he appointed his son Sextus king of the Gabii. The power thus acquired by oppression and dishonour could not last long. Among the injured parties was one Marcus Junius, who had married the daughter of Tarquinius Priscus. His son Lucius Junius Brutus had assumed idiotcy, to evade the cruelty of the tyrant. Titus and Arunx the sons of Tarquin, were sent to consult the oracle at Delphos respecting the plagues which had broken out at Rome; and they took along with them the supposed idiot for the purposes of amusement.

Sextus Tarquinius, having conceived a passion for Lucretia, the wife of Collatinus, the nephew of Tarquin, paid a visit to her house in her husband's absence. In the dead of night he entered her apartment, and demanded her person at the risk of her life. The virtuous Lucretia resisted his entreaties, but when the monster threatened to kill one of her male slaves and lay him naked by her body, he extorted from her dread of shame what she would have prevented at the risk of her own life. Next morning she sent for her husband and her father, and after entreating them to revenge her wrongs, she stabbed herself with a dagger which she had concealed beneath her robes. Brutus, who was present at this tragical event, drew the dagger from its wound, and swore by the blood which stained it, that he would be revenged on the tyrant and his hated offspring. The assembly took the same vow. They shut the gates of the city of which Lucretius was governor. They exposed the body of Lucretia to public view; and Brutus explaining the reason why he had counterfeited mental imbecility, exhorted the people to aid him in expelling the tyrant. The senate decreed his expulsion. Tarquin was deposed, and the government of Rome was vested in two consuls.

The establishment of a republic being approved of by all classes of the people, Brutus and Collatinus were proposed as the first two consuls. Having in vain attempted to enter the city, and finding that the army had been gained over to the new state of things, Tarquin, at the age of 76, was compelled to take refuge along with his wife and three sons, with his son Sextus, king of the Gabii. In the mean time, the consuls endeavoured to secure the liberties of the republic. They assembled the people by centuries; they confirmed the expulsion of Tarquin—they elected a *rex sacrorum* to superintend their religious affairs, and they revised many of the salutary laws of Servius Tullius. The restless spirit of Tarquin, however, succeeded in disturbing the tranquillity which these wise measures seemed so well calculated to secure. After many attempts to regain his authority, he contrived, by means of his ambassadors, to organise a conspiracy in his favour, in which were implicated three sons of Collatinus's sister, two brothers of the wife of Brutus, along with Titus and Tiberius, Brutus's own sons. The proceedings of the conspirators having been overheard by Vindicius, a slave, they were immediately apprehended. Brutus sat as the judge of his own sons, and with the feelings of a true patriot, he passed the stern decree that they should be beheaded in his presence. When the sentence was executed, he quitted the tribunal, and left Collatinus to preside at the other trials. Collatinus, however, allowed his feelings to soften the demands of justice; but the people called aloud for Brutus, and by a decree of the council, the other traitors suffered the punishment which they so justly merited. Vindicius received his liberty; the palaces of the Tarquins were destroyed, and the lands divided among the poor.

In consequence of the abdication of Collatinus, rendered necessary by his recent pusillanimity, Valerius was chosen to supply his place. The Volsci and the Tarquinienses now united their forces at the instigation of Tarquin. Brutus at the head of the cavalry, and Valerius at the head of the infantry, marched out to meet them. A personal combat took place between Brutus and Arunx, one of Tarquin's sons, and both of the combatants fell. The battle raged with the utmost fury till night, when some supposed stratagem of Valerius influenced the superstitious minds of the Volsci, and caused them to quit the camp in confusion.

The great attachment of Valerius to the interests of the people, procured for him the surname of *Poplicola*, and at the expiration of his consulship he was re-elected along with Titus Lucretius, the brother of Lucretia. While they were providing against an incursion from the Latins, Porsena, king of Clusium, in Hetruria, commanded the Romans either to take back the Tarquins, or to restore them their estates; and he supported the demand by a formidable army which marched towards Rome, and was joined by the exiles, and by the Latins, under Mamilius, the son-in-law of Tarquin. The Romans were soon driven from the fort Janiculum, but they made a bold stand at the bridge which separates the fort from the city. Victory, however, declared for the Hetrurians; but Horatius Cocles, the Consul's nephew, with Sp. Lartius and T. Herminius, who had commanded the right wing, posted themselves at the entrance of the bridge, and maintained it for a long time. The defensive arms of Lartius and Herminius having been broken, they retired across the bridge, and Horatius having desired them to have the bridge cut down at the other end, he sustained, single handed, the whole force of the enemy. Being at last wounded in the thigh, and perceiving that the bridge was nearly broken down, he leapt into the river, and swam across it amid a shower of darts.

The dangerous position in which Rome was now placed, excited a young patrician, Mutius Cordius, to attempt the assassination of Porsena. In the disguise of a peasant he penetrated the king's tent; but mistaking the richly dressed secretary for the king, he instantly slew him. When seized and brought before Porsena, he expressed in his countenance the disappointment which he felt, and he thrust his right hand into a pan of burning coals which stood by. Porsena, admiring his courage, granted him his life and liberty, and even returned the dagger which had been aimed against himself. Mutius, however, deceived the Tuscan king, by the declaration that 300 young Romans had sworn to take away Porsena's life; and hence he was induced to enter into an amicable arrangement with the Romans. This wise resolution was confirmed by an act of treachery on the part of the Tarquinian exiles, which had placed his own life in imminent danger. He ordered them to leave his camp, concluded a peace with Rome and left behind him all the corn and provisions which he had accumulated.

Conspiracy discovered.

Although the generosity and wisdom of Porsena had thus relieved Rome from the greatest danger that had ever threatened her, yet the persevering ambition of the Tarquins soon succeeded in besetting her with new difficulties. A conspiracy of the slaves to burn the city was no sooner discovered and put down, than a more general one, embracing the lower classes of the citizens was completely organized. Sulpitius, one of the consuls, having been put in possession of all their plans, contrived by the help of the two informers to have the conspirators assembled in the forum, which he invested with a body of chosen troops. The people were convened by curiæ, and made acquainted with the conspiracy. The conspirators were unable to make any defence when they were called upon, and sentence of death decreed by the Senate, was approved of by the people. When these steps were taken, the people were ordered to retire, and the conspirators were put to the sword. The two informers were highly rewarded, and the deliverance of the city was marked by festivities, expiations, and public games. The general joy, however, was disturbed by the death of Manlius Tullius, the consul, who fell from his chariot when the people were conducting him from the Circus to his own house.

Appointment of a dictator.
B. C. 498.

The reduction of the city of Fidenæ by the Romans, incited the Latins to make a vigorous attempt against Rome. A spirit of mutiny, however, arose among the nobles and the lower classes. They loudly demanded a remission of their debts; and though various expedients were proposed to quiet this turbulent disposition, yet it was found necessary to place the commonwealth under a dictator, with absolute power. When the popular concurrence was obtained to this measure, Titus Lartius, one of the consuls, was elected to the high office. Lartius chose Sp. Cassius, general of the horse, which gave him the second station in the republic; and from the pomp and state in which the dictator always appeared, the seditious were overawed, and the Romans again united against their common enemies. Lartius raised four armies, and having succeeded by his skill and his moderation in restoring the republic to its former tranquillity, he resigned the dictatorship.

Battle of Regillus.
B. C. 495.

A new war having been excited by the Tarquins, Posthumius was appointed dictator. With an army of 40,000 foot and 3000 horse, commanded by himself, by Virginius, and Ebutius Elva, general of the horse, he encamped on a steep hill, near Lake Regillus, while Virginius posted himself on another opposite, and Ebutius occupied a third eminence. Lucius Tarquin attacked Ebutius, but he was thrice repulsed with great loss. Having learned from two intercepted couriers, that in a few days the Volsci and Hernici were to join the Latin forces, Posthumius immediately gave them battle. At the commencement of the affair Titus Tarquinius engaged the dictator in single combat; being wounded in the side by Posthumius's javelin, the Latins began to retire; but being rallied by Sextus Tarquinius, the field was contested with great violence. The generals on both sides displayed great skill and personal bravery; and when victory was doubtful, it was agreed to decide it by single combat. Ebutius and Mamilius were thus brought into contact, and in a short time both of them were wounded and fell from their horses. Marcus Valerius, who succeeded Ebutius in his command, renewed the general engagement, but he was immediately wounded, and his nephews, the two sons of Poplicola also fell. The Roman left wing thus disheartened by the loss of their leaders, began to give way; but Posthumius, with a body of Roman knights, brought them back to the charge, and obliged the enemy to retire in confusion. At that critical juncture Titus Herminius rallied some of the flying troops, and fell upon some close battalions under Mamilius; he slew Mamilius with his own hand, but he himself received a fatal wound while he was stripping the body of his enemy.

While the battle was raging between Sextus Tarquinius and the Roman left, under Virginius, which had begun to give way, it was unexpectedly supported by the dictator. The career of Sextus being thus checked, he threw himself in distraction in the middle of the Roman knights, and perished bravely among their swords. The Latin army was thus entirely routed and destroyed, and when the Volsci and Hernici arrived next day, they found it more prudent to retire than to try their strength with a victorious though exhausted army.

The Latins yielded entire submission to the Roman power, and having agreed to abandon the Roman exiles, Tarquin retired to Aristodemus, king of Cumæ, where he died in the 90th year of his age, and the 14th of his exile.

The Volsci invade Rome.

No sooner were the Romans delivered from their foreign enemies, than they began to oppress each other at home. The Patricians and the Plebeians cherished opposing interests; and in the midst of the disturbances which were thus excited, the Volsci, Hernici, and Sabines advanced to the gates of the city. P. Servilius succeeded in raising a small army, with which he defeated the enemy in a pitched battle, and took and plundered their capital. He then marched against the armies who had entered Latium, and compelled them to retire into their own territories.

Notwithstanding these successes Rome was again agitated with fresh dissensions. The Sabines invaded the republic and were beaten; but the army revolted and retired precipitately to a hill, afterwards called Mons Sacer, about three miles from Rome, where they continued till the Senate agreed to institute tribunes of the people, whose persons were to be sacred, and who were to have the power of preventing any law from being passed which was prejudicial to the people.

491 B. C.

Institution of Tribunes of the People.

The people being thus reconciled to the Senate by the predominance thus given to their own order, made no opposition to the levies which were required against the Volsci. The Consul Cominius, after defeating them in battle, and taking Longula and Polusia, marched against Corioli, a city strongly fortified. The scaling party being repulsed at the first attempt, were rallied by Caius Marcius, who led them back to the walls, and made himself master of the city. He afterwards marched against the Antiates, who had come to relieve the city, and defeated them after displaying the greatest bravery.

491 B. C.

Caius Marcius receives the surname of Coriolanus.

The Consul Cominius assembled the army next morning, pronounced a panegyric upon Marcius, put a crown upon his head, and bestowed upon him the surname of *Coriolanus*. The army returned to Rome, and the arts of peace flourished for a while.

The neglect of agriculture, which had arisen from the revolt of the army, occasioned a severe and destructive famine; and it was only by the breaking out of a dreadful pestilence among the Volsci that Rome was protected from their incursions. The distresses and hunger of the lower orders excited disturbances in Rome, which the tribunes of the people made it their business to exasperate. The most violent and indecent contentions took place; and when a large supply of corn arrived from Gelon, King of Sicily, Coriolanus insisted that it should not be distributed till the grievances of the senate were redressed.

The resentment which this proposal excited, encouraged the tribunes of the people to devise charges against that intrepid warrior. They charged him with aspiring to the sovereignty, and accused him of having embezzled the plunder of Actium. Summoned to stand trial before the people, this great general, who had saved his country, appeared unconcerned before the august tribunal. Neither his sorrow nor his eloquence could save him. He was condemned to perpetual exile; and having returned home to take leave of his wife, his children, and his mother Veturia, he took refuge with Tullus Atticus, a powerful Volscian.

The Volscians soon found reason for availing themselves of the injury done to Coriolanus, and war having been formally proclaimed, the Volscians laid waste the Roman territory, with a powerful army, commanded by Coriolanus and Tullus. The most unexampled success followed all their operations, and the city itself was speedily invested by their triumphant arms. When the Romans saw no hope but in submission, they sent embassy after embassy to avert the fate which awaited them; but when all these attempts proved fruitless,—when the pontiffs, the priests, and the virgins returned from the inflexible Coriolanus, despair seized upon all ranks, and hurried the old and young to the shelter of the altars. The last resource, however, was suggested. A deputation of Roman matrons, attended by Veturia, and Volumnia, the mother, and the wife of Coriolanus, and by his own children, set off to the hostile camp, to make a last intercession for their country. When he saw from afar the approach of the mournful train, Coriolanus assembled his officers to witness the resolution which he had summoned up for the interview; but when he learned that his wife and mother were amongst the supplicants, the sternness of the warrior could not resist the claims of natural affection. The eloquence with which they pleaded for their country was irresistible, and raising his mother from her feet, he exclaimed, "Thou hast saved Rome, but lost your son." The besieging army was withdrawn; but the lenity which was thus shown to the Romans was avenged by the Volsci, who slew Coriolanus during an insurrection of the people which followed their return from Rome.

The attempt of the Roman people to pass the agrarian law, by which the lands of the commonwealth were to be equally divided among the inhabitants, created party dissensions between the Senate and the people. Under these circumstances the consuls had recourse to the influence of a dictator. Quintus Cincinnatus was chosen for that high office; and the senatorial deputies found him in the attire of a husbandman tilling the ground with his plough. By wisdom, moderation, and justice, Cincinnatus succeeded in softening the animosities of the contending factions. He ordered the tribunes to postpone the consideration of the agrarian law, and when he gave tranquillity to his divided country, he retired again to enjoy the seclusion of a rural life.

The tranquillity of Rome was again disturbed by an incursion of the Equi and Volsci. The Consul Minucius was sent to oppose them; but he unskilfully permitted his army to be driven into a defile between two mountains, from which there was no escape but through the ranks of the enemy. Some knights who had contrived to find their way through the enemy's camp, brought the news of their disaster to Rome. In this alarming crisis all eyes were again directed to Cincinnatus, whom it was resolved to make dictator. Taken a second time from the labours of rural industry, he hastened to provide for the pressing exigency of the Roman army. He chose a poor man, Tarquitius, to be master of the horse. He assembled before sunset all who could bear arms, and providing them with corn, and with five days provisions, he marched all that night, and arrived at day break before the camp of the Volsci. He intimated, by the loud shouts of his army, that succour was at hand, and immediately threw up entrenchments to prevent the escape of the Equi, who were thus enclosed between two enemies. A furious combat ensued. The Equi, assailed on both sides, offered Cincinnatus his own terms. The generals and captains were made prisoners of war. The enemy's camp was given up to plunder; and after Rome was thus saved from imminent danger, Cincinnatus resigned his dictatorship, which he had held for a fortnight, and retired to the tranquillity of a country life. The agrarian law again agitated the contending factions. Licinius Dentatus, a plebeian veteran of extraordinary bravery, who had fought in 120 battles, and gained all kinds of military honours, pleaded the cause of the people, by the eloquence of his scars. The measure, however, was violently opposed by several young patricians, who broke the balloting urns, and dispersed the multitude that threatened to oppose them. The tribunes joined the offending parties, but declined to press the obnoxious measure.

Both the Senate and the people were tired with the endless discussions which had taken place between them; and all parties concurred in the opinion, that these evils might be greatly removed by the enactment of wholesome laws. Three ambassadors, Posthumius, Sulpicius, and Manlius, were accordingly sent to collect the legislative wisdom of Greece; and after a year's absence, during which time Rome was depopulated with the plague, they returned with a body of laws which, when digested into ten tables, and two additional ones added, formed the celebrated code of the *Laws of the Twelve Tables*, of which some fragments still exist.

In order to digest these new laws, and to carry them into effect, ten of the principal senators were chosen, whose power should be annual, and equal to that of kings and consuls, without any appeal. Thus clothed in absolute power, the decemvirs discharged their duties with zeal and industry; but at the expiration of their year of authority, they were permitted by the Senate to continue in office, on the ground that laws were yet necessary to complete the code.

When this pretence could no longer be urged, the decemvirs openly resolved to continue in power. The popular discontents which were thus excited, called forth fresh acts of tyranny on the part of the decemvirs. The very property of the people was seized, and a system of slavery and proscription was thus organized into law.

Amid these intestine divisions the Equi and Volsci advanced within ten miles of Rome. The leading members of the decemvirate took the command of the army; but in order to punish their generals, the Roman soldiers shamefully abandoned their camp on the approach of the enemy. When the news of this defeat reached Rome, the blame was thrown upon the generals; some cried out for a dictator, and the veteran Dentatus spoke with openness and freedom of the commanders. Enraged at this treatment, Appius, the principal leader marked out Dentatus for destruction, and under the pretence of doing him honour, he was sent from Rome with supplies for the army. The aged hero was received most respectfully at the camp. Having found fault with the situation of it, he was put at the head of 150 men, to discover a more commodious place. The soldiers who attended him were ordered to assassinate him. They conducted him into the hollow of a mountain and attacked him from behind. The brave veteran saw the design of his enemies; he placed his back against a rock, and killed fifteen of his assailants, and wounded thirty. He kept off their javelins with his shield, but he at last sunk beneath the stones which they hurled down upon him from above. The decemvirs decreed him a public funeral with military honours, but their pretended sorrow only added to the detestation in which they were so justly held.

Death of Dentatus.

Story of Virginia.

An event of a still more horrible nature opened the eyes of the Romans to a deep sense of the oppression under which they groaned. Appius conceived an incontrollable passion for Virginia, the daughter of Virginius, a centurion. This lady, who was only fifteen years of age, possessed the most exquisite beauty, and was betrothed to Julius, formerly a tribune of the people. Appius would have himself married Virginia, had the new laws permitted the Patricians to intermarry with the Plebeians; but finding that impossible, he adopted the most flagitious measures for gaining possession of her person. He bribed one Claudius to maintain that Virginia was his slave, and to refer the question to the decision of his own tribunal. The cause accordingly came on; the miscreant Claudius maintained that she was born of a female slave in his own house, and that that slave sold her to the wife of Virginius when she was born; and he offered to produce witnesses to these facts. Appius decided that Virginia should be kept by Claudius till Virginius's arrival; but the clamours of the multitude became so violent that Claudius fled from their fury, and Appius was obliged to suspend his judgment. The following day was fixed for the trial. Appius wrote to the General to confine Virginius, who was with the army, about eleven miles from Rome; but these letters were intercepted by the friends of the centurion, who made him acquainted with the plot which had been laid against his own liberty, as well as the honour of his only daughter. Indignant and bent on revenge, the centurion obtained leave to go to Rome, and appeared next day at the tribunal of Appius, conducting his only daughter, clad in the deepest mourning. When Claudius had repeated his story, Virginius declared that his wife had many children, that hundreds had seen her pregnant; and that Virginia had been nursed by her. The people saw at once the justice of his cause, but the brutal consul did not hesitate to adjudge her to Claudius, and to order the lictors to carry her away. Virginius apparently acquiescing in the sentence, wished permission to take a farewell of his child; and while he was supporting his distracted daughter in his arms, he seized a knife, and buried it in her breast. Brandishing in his hand the bloody weapon, he exclaimed, "By this blood, Appius, I devote thy head to the infernal gods," and running wildly through the city, he roused the people to arms, and hastening to the camp, he spread the same flame through the army, who instantly left their generals, and again took their stations on Mount Aventine. The army which opposed the Sabines, joined them in large parties, and all the attempts of Appius to quell the general insurrection were utterly fruitless. The Senate yielded to the wishes of the army. The decemvirs were abolished. Appius died by his own hands in prison. Oppius, one of his colleagues, shared the same fate, and the other decemvirs fled from the country.

The demands of the popular party now became more clamorous, and the Senate was obliged to pass a law which permitted the Plebeians to intermarry with the Patricians. Still, however, they were not satisfied, and had recourse to their former plan of refusing to enlist upon the approach of an enemy. In order to remedy this evil, it was agreed to appoint military tribunes, who should have the power of consuls; but this measure, though carried into effect, was neither useful nor popular; and consuls were again appointed, who were to be assisted by censors, chosen every fifth year. The first two censors were Papirius and Sempronius; and the office was filled for 100 years by Patricians.

Mælius aims at the sovereignty.

The tranquillity which followed these changes, though enlivened by the triumph gained by the Consul Geganius, over the Volsci, was disturbed by a famine which occasioned new discontents. In this conjuncture, Spurius Mælius, an opulent merchant, bought up all the corn in Tuscany, and distributing it among the poor, he acquired a sort of influence which prompted him to aim at the sovereignty of Rome. The plot which he had for this purpose organised was detected by Minucius. The election of a dictator was again resorted to, and Cincinnatus, at the age of 80, was again summoned to the deliverance of his country. Mælius was commanded to appear before him, but having refused to obey, Attila, master of the horse, killed him on the spot. Cincinnatus commended the heroism of Attila, and ordered the house of Mælius to be demolished, and his goods divided among the poor.

War with the Veientes.

The insolence of the Veientes induced the Romans to resolve upon the destruction of their capital. This resolution, however, was more easily made than executed. The Roman army which invested Veii, continued their operations with various success for ten years. The loss which they sustained had become very alarming to the state, and a law was on that account made, that the bachelors should marry the widows of the soldiers who were slain. Vigorous measures, however, now became necessary, and Furius Camillus was chosen dictator, for the purpose of putting an end to the war. Already distinguished as a military tribune and as a consul, he had acquired the confidence of the people. Unable to take Veii by force of arms, he contrived by arduous labour to carry a mine beneath the citadel. When the operations were nearly finished, he wrote to the Senate, requesting that all who wished to partake in the plunder of Veii should repair to the army; and having directed his men how to get through the breach, his legions entered without opposition, to the utter consternation of the besieged, who were unable to make any effectual resistance. The fortunate issue of this siege, while it rewarded the victors, gained a splendid triumph for the general who achieved it.

Camillus takes Veii,

and Falerii.

The same good fortune attended the arms of Camillus, in an expedition against the Falisci. When the capital Falerii was vigorously resisting the Roman arms, a schoolmaster contrived to decoy the children whom he taught to the Roman camp, for the purpose of putting them into the hands of Camillus. Horrified with this act of treachery, Camillus ordered the miscreant to be stripped, to have his hands tied behind his back, and to be whipped into the town by his own scholars. Struck by the generosity of this action, the magistrates of Falerii submitted to the Senate; and the city was received into an alliance with the conquerors.

Notwithstanding these signal triumphs, Camillus speedily felt the ingratitude of his countrymen. Petty charges were constantly brought against him, and, resolving to avoid the ignominy of a trial, he embraced his wife and children, quitted Rome; and as he was about to leave its gates, he turned his face to the capitol, and with uplifted hands he prayed to the gods, that his country might one day be sensible of their injustice and ingratitude.

The destinies of Rome soon required to be guided by the spirit of Camillus. An army of Gauls under Brennus, had been for some years occupying the country from Ravenna to Picinum, and were slowly advancing to the Roman territories. At the instigation of Aruns, a wealthy Clusian, who had been ill used by the magistrates, Brennus laid siege to Clusium. The Romans sent three young patricians of the Fabian family to offer their mediation between the Gauls and the Clusini; but they accompanied this offer with the taunting request, to know the pretences which a remote nation could have upon Hetruria. Brennus replied, that every thing was the property of the brave; that his right lay in his sword; and that the Romans themselves had in all their conquests acknowledged no other right than that which the strong exercises over the defenceless.

The Fabii smothered the feelings which that answer excited, and obtained leave to enter Clusium, to confer with the magistrates. Forgetting the character with which they were invested, Q. Fabius headed a sally against the besiegers, and slew with his own hand one of the chief officers of the Gauls. Incensed at this act of treachery, Brennus raised the siege, and marched deliberately to Rome at the head of 70,000 men. A herald who preceded him, demanded that the Fabii should be delivered up to him; but the senate having referred the question to the people, the request was not only refused, but at the next election the Fabii were chosen the first three of the military tribunes.

After this expression of popular opinion, Brennus proceeded on his march. An army of 40,000 men, commanded by the six military tribunes, marched out against him, and the hostile armies met near the river Allia, about sixty furlongs from Rome. The flower of the Roman army, amounting to 24,000 men, was posted between the river and the neighbouring fields, while the remainder occupied the hills. Brennus attacked the latter, and having soon thrown them into disorder, the forces on the plains were panic struck, and fled without drawing their swords. Most of the Roman soldiers fled to Veii, others were drowned in the Tiber, many fell beneath the avenging sword of Brennus; and a few who fled to Rome, filled the capital with terror and consternation. Brennus marched towards Rome, and encamped on the Arnio. The Romans, abandoning the city, retired into the capitol, with all that could bear arms; while the old men, women, and children, sought for refuge in the neighbouring towns. The vestals carried off the sacred utensils to *Cære*, in Hetruria, where they performed their sacred rites, which were hence called Ceremonies. About eighty of the most illustrious and venerable old men in Rome resolved to await their destiny in the city, and, clothed in their pontifical, consular, and triumphal robes, they seated themselves in their usual chairs in the forum,

After many needless precautions, Brennus entered Rome four days after the battle of Allia. Advancing into the forum with his troops, he saw with amazement the band of old men who had devoted themselves to death. The troops at first kept aloof from the sacred group; but a soldier, more adventurous than the rest, having from curiosity touched the beard of M. Papirius, the old Roman struck him with his ivory staff, when the soldier instantly slew him; and the Gauls following his example, slaughtered without mercy this little band of devoted patriots. The city was now delivered up to pillage; the inhabitants were put to the sword without distinction; and Brennus having been repulsed in an attempt upon the capitol, he burnt the city, demolished the temples and public buildings, and razed the walls to the very earth.

Brennus now converted the siege of the capitol into a blockade, but, from the scarcity of provisions, he was compelled to raise contributions in the neighbouring cities. When one of these foraging parties appeared before Ardea, Camillus, who had spent two years as a private individual in that city, encouraged the Ardeates to arm their youth in the defence of their city. This unexpected resistance brought the army of the Gauls before Ardea; but, despising the Ardeates, they devoted themselves to drunkenness, and no longer preserved any order or discipline in their camp. At the head of a chosen band Camillus surprised the camp in a dark night, and when the troops were drowned in wine he made a dreadful slaughter among them, while those who escaped were massacred without mercy by the peasants. This unlooked-for success revived the drooping spirits of the Romans.. The wreck of the army defeated at Allia rallied under his standard; but though he was urged to take the command of them, he refused till he received a regular appointment from the people.

In this emergency Pontius Cominius, a bold but ambitious plebeian, threw himself into the Tiber early in the night, and suffering himself to be floated down with the stream, landed at the foot of the capitol, at a steep place where no centinels were placed. Mounting its precipitous sides, he informed the besieged of the success of Camillus; and the senate being assembled, and the Curiæ called together, the condemnation of Camillus was abrogated, and he was unanimously appointed dictator. Cominius soon returned with the joyful tidings, and in a short time Camillus found himself at the head of 40,000 men.

In walking round the base of the capitol, some of Brennus's soldiers observed the print of Cominius's feet and hands on the side of the hill, and having communicated the intelligence to their leader, he resolved to enter the capitol by the same path. He accordingly selected a determined band of mountaineers, who climbed the rock, and entered the citadel without alarming either the sentinels or the dogs. A flock of geese, however, was frightened at their approach, and running up and down cackling and flapping their wings, they awakened Manlius, who mounted the ramparts, slew one of the assailants, and precipitated another from the top of the rock. The Romans in the mean time assembled in numbers, and speedily dispersed the Gauls, the greater number of whom threw themselves over the rock, in order to escape the swords of the enemy.

Next morning the tribune Sulpitius assembled the troops. They rewarded Manlius for his courage; executed the captain of the guard for his negligence; and resolved that a flock of geese should ever afterwards be kept in Rome at the public expence.

While Brennus continued the siege of the capitol, he was himself hemmed in by the activity of Camillus. Famine added itself to the other calamities both of the Gauls and the Romans; and a plague broke out in the camp of Brennus, which was pitched among the ruins of the city, and the bodies of the unburied Romans.

Sulpitius negociates with the Gauls.

The brave defenders of the capitol were ignorant both of the distresses of their enemies, and of the active exertions of their friends. Famine had reduced them to the last extremity of distress, and seeing no prospect of deliverance, Sulpitius was compelled to negociate with the Gauls. On the condition that the Roman territory should be evacuated, Sulpitius agreed to pay 1000 pounds weight of gold, (£45,000); but after the gold was brought, the Gauls weighed it with false weights; and when Sulpitius complained of the deception, Brennus threw his sword and belt into the scale, and exclaimed *Væ victis*.

Camillus interferes.

While the broken spirit of the Romans was thus insulted amid the ruins of their city and of their fortunes, Camillus appeared at the gates with his army. With a chosen band he hastened to the conference, and learning on his way the insolence of Brennus, he exclaimed as he approached, "Carry back the gold into the capitol, and you Gauls retire with your weights and scales. Rome must be ransomed by steel and not by gold." Brennus replied that the treaty was ratified by mutual oaths; but Camillus, as invested with the supreme power, declared the contract to be void. Brennus flew into a rage, and both parties having drawn their swords, the Gauls after some loss retired into their camp, which they abandoned in the night, and, after a march of eight miles, encamped on the Gabinian way. Camillus pursued them at break of day, defeated them after a faint resistance, and put great numbers to the sword. Besides those which were slain in the action and in the retreat, numbers were killed by the peasants, and not a Gaul survived to carry home to his country the tidings of this memorable action. Loaded with the spoils of the barbarians, Camillus returned triumphant to the city, and was honoured as the father of his country, and the second founder of Rome.

Camillus destroys the army of the Gauls.

The almost total destruction of the city induced many of the tribunes to propose to abandon it, and remove the seat of government to Veii, a city strongly fortified both by nature and art. The people were disposed to enter into the measure; but Camillus, supported by the senate, urged the rebuilding of Rome by every appeal which could be made to their interests and feelings. When the question was about to be decided, L. Lucretius was beginning to speak, when a centurion exclaimed in passing by, "Plant your colours ensign, this is the best place to stay in." Lucretius taking advantage of the words, cried out, "A happy omen; I adore the gods who gave it." The senate applauded his speech, and the decree for rebuilding Rome was passed without opposition.

Rome rebuilt.

The rebuilding of the city was scarcely completed, when the Equi, Volsci, Latins, and Hernici, entered into a formidable combination against the Romans. Camillus was a third time chosen dictator, and having made Servilius his general of horse, he marshalled the citizens of all ages, and formed three armies. One was placed under A. Manlius, the second was sent to the neighbourhood of Veii; and at the head of the third he marched to the relief of the tribunes, whom the Volsci and Latins had closely besieged in their camp. Upon the arrival of Camillus, the Volsci and Latins fortified their camp with huge trees newly cut down. Observing that the wind blew full on the enemy's camp, the

Camillus defeats the Volsci.

dictator ordered a detachment to proceed with firebrands to the windward side to set it on fire, while with the main body he obtained possession of it, and leaving his son in it to guard the prisoners, he made himself master of Bola, the capital of the Equi. He then carried his arms against the Volsci, whom he speedily subdued.

Camillus relieves Sutrium.

The town of Sutrium, in alliance with the Romans, having been invested with a powerful Hetrurian army, Camillus set out for its relief; but the want of provisions forced them to surrender before his arrival. The inhabitants, deprived of every thing, had set out in quest of new habitations, and fortunately fell in with Camillus's army. The dictator encouraged them to return; and arriving at Sutrium when the Hetrurians were engrossed with the plunder of the city, he put them to the sword, and restored the city to its rightful owners. After these brilliant exploits, Camillus entered Rome in triumph, and resigned the dictatorship.

During the subsequent administration of the six military tribunes, new works were added to the part of the capitol which had been scaled by the Gauls; the territory of the Equi was laid waste; and the two cities of Cortuosa and Contenebra were taken from the Hetrurians, and demolished.

Defeats the Antiates,

The approach of a new war induced the people to elect Camillus one of the military tribunes. The rest of his colleagues agreed to give him the sole direction of affairs in time of war; so that without the name he possessed the powers of a dictator. His first enterprise was against the combined armies of the Antiates, the Latins, and the Hernici; but his troops showing an unwillingness to engage an enemy so superior in numbers, Camillus mounted his horse, encouraged all the ranks of his army, and dismounting and seizing the nearest standard-bearer by the hand, he called upon the soldiers to advance. He was immediately followed by his troops with a great shout, and having thrown a standard among the enemy's battalions, the soldiers struggled to regain it, and speedily broke the ranks which opposed them. The Antiates were completely routed. The Latins and Hernici returned home, and the Volsci retreated into Satricum. Camillus invested this city, and, having taken it by assault, he forced the Volsci to surrender at discretion.

and succours Nepet and Sutrium.

Camillus was now called upon to succour the allied cities of Nepet and Sutrium against the Hetrurian power. Sutrium had nearly yielded to the besiegers when Camillus arrived. Dividing his army into two bodies, he ordered Valerius to march round the walls as if he meant to scale them, while he himself should charge the Hetrurians in the rear, and shut them up between the besieged and his own forces. The Hetrurians, seeing these plans, sought for safety in a disorderly flight, and left great numbers on the field who had fallen by the swords of the Romans. The city of Nepet, which had surrendered to the enemy, was also taken by assault, and the Hetrurians put to the sword.

Manlius Capitolinus aspires to the Sovereignty.

The splendid successes of Camillus eclipsed the military glory of all his contemporaries. Marius Manlius who had saved Rome by his bravery in the capitol, began to envy the fame of Camillus, and to abandon himself to those ambitious views which the circumstances of the times had induced him to subdue. His bravery had made him respected by all ranks, but it was through the affections and support of the people that he looked for the fulfilment of his plans. Profuse in the distribution of his money he soon acquired popularity among the needy, and availing himself of every opportunity of defending the rights of the people, and of calumniating the conduct of the patricians, he acquired great influence over the Roman populace. The military tribunes did not fail to see through the schemes of Manlius. It was now obvious to all that he aspired to the sovereignty of Rome, and being accused of this crime, he was found guilty, and thrown headlong from the capitol.

Having now subdued the nations which had so often threatened to destroy them, the Romans during the consulship of Valerius Corvus and Cornelius, turned their arms against the Samnites, a nation which inhabited a part of southern Italy which now belongs to the Neapolitan territory. Valerius Corvus was sent to relieve Capua, the principal town of Campania, while Cornelius led the Roman army to Samnicum. The Samnites, though the bravest of the enemies of Rome, were compelled to fly after many well-fought battles. Valerius was less successful than his colleague. Having inconsiderately led his troops into a defile, he was saved by the tribune Decius, who posted himself on a hill which commanded the enemy. This skilful manœuvre placed the Samnites between two enemies, and they were defeated with the loss of more than 30,000 men.

During the consulship of Manlius, a war broke out between the Romans and the Latins. The similarity between the arms and the language of the two people, rendered it necessary to prevent any confusion in the time of action. Orders were therefore issued by Manlius, that death should be inflicted on any soldier who should leave his ranks. When the armies were drawn out for battle, Metius, the commander of the Latin cavalry, advanced from the lines, and challenged to single combat any of the Roman knights. Indignant at the insult thus offered to his country, the consul's son, Titus Manlius, forgetting the stern order of the general, accepted the challenge and slew his adversary. Manlius sternly ordered his son to be beheaded, but his body, adorned with the spoils of Metius, was buried by the soldiers with military honours. The battle now began between the two armies, Manlius commanded the right, and Decius the left of the Romans. The augurs had foretold that if any part of the Roman army should be in distress, the commander of it should devote himself for his country. Accordingly when the Roman left began to give way, Decius determined to sacrifice himself to the Gods. After some idle ceremonies, he mounted his horse and carrying consternation and death wherever he appeared, he at last fell covered with glory. The Romans were inspirited while the Latins were disheartened by this act of magnanimous devotion. The ranks of the Latins began to give way, a total rout ensued; and the Romans pressing the victory with ardour, made such a carnage among the Latins that scarcely a fourth of the army survived the defeat. The vanquished Latins sued for peace, and some time afterwards entirely submitted themselves to the Roman sway.

The Samnites having been refused a peace from the Roman senate, Pontius their general resolved to obtain it by a stratagem. Occupying the defile of Claudium and defending all its outlets, he dressed ten of his soldiers as shepherds, who were instructed to throw themselves in the way of the Romans. The consul himself fell in with the shepherds, and having learned from them that Pontius's army had gone to besiege Luceria a town of Apulia, he marched straight through the defiles, and never suspected the stratagem till he found himself enclosed in the middle of the Samnite army. Stripping them of every thing but their garments, Pontius made them pass through the yoke, and stipulated that they should evacuate the territory of the Samnites. The Romans were deeply afflicted with this disgraceful treaty, but they soon found cause to break it. Under the dictatorships and consulates of Papirius Cursor, the Romans gained repeated triumphs over the Samnites, and by the exertions of Fabius Maximus and Decius, they were finally subjugated.

Alarmed at the increase of the Roman power, the Tarentines resolved to oppose them; but being devoted more to the pursuits of indolence and pleasure than to those of war, they invited Pyrrhus king of Epirus to lead their armies to battle. When the Roman general Emilius heard of this invitation, he carried on the war with greater vigour, and soon drove the Tarentine army within the walls of their capital.

The Tarentine ambassadors succeeded in making a treaty with Pyrrhus, who immediately dispatched his skilful general Cyneas with 3000 men to take possession of Tarentum. When he had, after much difficulty, got the command of the citadel, he solicited Pyrrhus to hasten into Italy. Emilius now resolved to go into winter quarters in Apulia, but his road lying through defiles flanked by lofty hills on the one side and by the sea on the other, he was unexpectedly attacked by the Tarentines and Epirots, who had posted archers and slingers on the hills, and armed several barks with ballistæ. Emilius, however, placed his Tarentine prisoners between him and the enemy, and thus made his way through the defiles without any farther molestation. In the following year Emilius was made proconsul.

Pyrrhus had no sooner arrived in Tarentum than he found the inhabitants engrossed with licentiousness and gaiety. They had expected that the Epirots alone were to brave the dangers of the war; but Pyrrhus resolved to reform them and to put an end to the divisions which were fomented by their idleness and vices. He prohibited their feasts, their masquerades, and their plays. He put down the harangues and debates of their demagogues; and, selecting the strongest of the youth he inured them to military exercises and the use of arms. The Tarentines could not brook such a system of severe and rigorous discipline; they complained loudly of their new ally, and even attempted to quit their country, but Pyrrhus made it a capital crime to abandon their territory, and increased the severity of his measures in proportion as they endeavoured to resist or evade them.

While Pyrrhus was thus disciplining the Tarentines, P. Valerius Lævinus the Roman consul entered Lucania and ravaged the country. Though Pyrrhus had not yet collected his contingents from the allies of the Tarentines, he yet ventured into the field, and advanced to the Roman camp on the banks of the Siris. Upon reconnoitring the camp from the opposite bank, and observing the entrenchments, and the good order which characterized the whole, he renounced his plan of attacking them, and waited in his own entrenchments for the reinforcements which he expected.

Pyrrhus's first battle with the Romans.

The Roman consul, however, was desirous of bringing Pyrrhus to a general engagement before the arrival of the confederate troops. He accordingly addressed his army, and drawing up his infantry on the banks of the Siris, the cavalry were ordered to make a great detour in order to cross some unprotected part of the river. Having succeeded in passing the Siris, the cavalry attacked the troops which Pyrrhus had drawn up in front of the Roman infantry, and thus gave time to the latter to cross the river by bridges which had been prepared for them.' In the mean time, Pyrrhus advanced with his army, in the hopes of destroying the Romans during the hurry and disorder of forming on the banks of the river; but the Roman cavalry kept the Epirots in check till the infantry were formed. At this early period of the action, Pyrrhus astonished the Romans by his bravery and skill. He had a horse killed under him at the first onset, and as a report had gone abroad that he was slain, he rode through all his ranks before he began the general attack. The richness of his equipments having marked him out to the enemy, he exchanged his dress and his helmet with his favourite Megacles, and thus masked he attacked the Romans with a vigour to which they had not been accustomed. The Romans bore the onset with undaunted firmness. The Epirots and the Romans gave way by turns, and by turns were rallied, and their leader Megacles, in the royal garb, was pursued by *Dexter* a Roman knight, who slew him and carried his dress and armour to the consul. When these were shown to the Epirots, they began to give way under the belief that their king had fallen; but Pyrrhus learning what had happened, rode bareheaded along the first lines of his army and raised their hopes and their courage.

Pyrrhus defeats the Romans.

Lævinus now ordered his cavalry to advance; but the moment this was observed by Pyrrhus, he brought twenty elephants in front of his army, having towers on their backs full of archers. Awed by the sight of these animals, which they had never seen before, the courage of the Roman cavalry began to abate; but as they advanced nearer to them, their horses took fright at the strange noise of the elephants, and either threw their riders or carried them off at full gallop. Although the cavalry were thus thrown into disorder, and many of them slain by the darts of the archers, yet the infantry still maintained their position till Pyrrhus at the head of his Thessalian horse attacked them in a furious onset, and forced them to repass the river in disorder, and take refuge in Apulia. Although Pyrrhus remained master of the field, yet he lost in this engagement many of his best officers and soldiers, and was heard to confess that another such victory would compel him to return to Epirus.

While he was engaged in burying the dead, with which the field of battle was covered, Pyrrhus is said to have observed that the Romans had all fallen by honourable wounds, and that the dead still grasped their swords in their hands. He remarked even in the faces of the slain a martial air and a boldness of aspect which drew from him the celebrated exclamation, "Oh that Pyrrhus had the Romans for his soldiers, or the Romans Pyrrhus for their leader—together we should subdue the whole world."

After repairing the disasters of this bloody engagement, Pyrrhus followed the Romans into the territories of their allies, and after advancing even into the neighbourhood of Rome, he made himself master of the greater part of Campania. Here he was joined by the Samnites, the Lucanians, and the Messapians, and with these reinforcements he laid siege to Capua. Lævinus, however, forced him to raise the siege, but Pyrrhus turning all on a sudden towards Rome by the Latin way, surprised Fregellæ, and passing through the territory of the Hernici, he arrived at Præneste. Here he is said to have obtained a sight of Rome from the top of a hill, and even to have driven a cloud of dust into the city. Titus Coruncanius the other consul, having returned from the reduction of Hetruria with his victorious army, compelled Pyrrhus to raise the siege of Præneste, and to retrace his steps into Campania. Here he found Lævinus with a more powerful army than the one he had defeated. The Roman consul endeavoured to bring him to a battle, but Pyrrhus declined it, and terminated the campaign by retiring to Tarentum.

Pyrrhus is desirous of peace.

The knowledge which Pyrrhus had acquired of Roman valour, pointed out to him the prudence of seeking an honourable peace. He learned, therefore, with joy that three ambassadors had been sent to him from Rome; but he was mortified to find that their only object was to redeem 1800 prisoners whom he had taken. After consulting his council, Pyrrhus released 200 of the prisoners without ransom, and permitted the rest to return to Rome on their parole, to celebrate the saturnalia in the midst of their families.

Having thus created a friendly disposition in his favour, he dispatched his faithful general Cyneas to Rome to conclude a peace. The conditions, however, which he proposed, though by no means unfavourable to Rome, were nevertheless violently opposed by Appius Claudius, an old and blind orator, who prevailed upon the conscript fathers to reject all offers of peace till Pyrrhus had quitted Italy.

Prepares for a new campaign.

Pyrrhus had now no other course than to prepare for a new campaign. The Roman army under the consuls, P. Sulpicius Saverrio and P. Decius Mus, marched into Apulia, and having found Pyrrhus encamped near Asculum, they fortified a position at the foot of the Appennines, separated from the enemy by a broad river which flowed through the plain. The Romans crossed the river, and drew up in order of battle on the plain; their centre, consisting of four legions, who were to engage the phalanx of the enemy, while the Roman cavalry and the light armed auxiliaries were placed in the wings. Pyrrhus likewise marshalled his troops with that consummate skill which he possessed, having in the centre his phalanx, on the right wing his Epirots and Samnites, and on his left the Lucanians, Bruttians, and Salentines. The Romans had provided chariots armed with scythes, and filled with soldiers carrying firebrands, to frighten the elephants and burn their wooden towers, and they directed a body of Apulians to attack Pyrrhus's camp during the battle. The contest at last began. The central phalanx of Pyrrhus sustained the furious attack of the four legions; but being compelled to give way, Pyrrhus marched round his elephants against the Roman cavalry which were thus thrown into disorder. The phalanx again returned to the charge, and drove back the Roman legion, who left their consul Decius among the dead. The preconcerted attack of the Apulians, however, upon the enemy's camp turned the fortune of the day. The king was obliged to send a strong body to defend it, and the Epirots thinking that their entrenchments were forced, lost their courage and began to retire. The whole army followed their example, and though Pyrrhus strove to rally them, and returned to the battle with a small band of his friends and officers, yet his gallant exertions were fruitless, and after being severely wounded, he retired with his band of heroes, and left the Romans in possession of the field. Unable to pursue the advantage which he had gained, Sulpicius recrossed the river, and returned to his camp; but when he found that Pyrrhus had retreated to Tarentum, he put his army into winter quarters in Apulia.

Pyrrhus defeated by the Romans.

The Roman army again took the field under the command of the new consuls, C. Fabricius and Q. Emilius Pappus. Advancing into the territory of Tarentum, they came up with Pyrrhus, and while they were waiting for a favourable opportunity of giving him battle, his physician Nicias brought a letter to Fabricius offering to poison his master. The consuls were so shocked with the proposal that they wrote a letter to Pyrrhus informing him of the traitorous plans of those around him. Grateful for this mark of kindness, Pyrrhus immediately released the Roman prisoners without ransom; but the consuls, unwilling to accept of a favour, sent back to Pyrrhus an equal number of Tarentines and Samnites. Unable to procure an honourable peace with the Romans, and sensible of his want of resources to withstand their military prowess, Pyrrhus accepted of an invitation from the Sicilians to assist them against the Carthaginians. He, therefore, set out for Sicily with a fleet of 200 ships, and an army of 36,000 infantry, and 2500 cavalry. His success was at first brilliant, but the severity of his exactions alienated the affections of the Sicilians. A powerful Carthaginian army speedily recovered the cities which Pyrrhus had taken, and he found himself unable to resist their overwhelming force. See our article Carthagena, vol. V. p. 570. His presence in Italy being anxiously demanded by the Tarentines, Pyrrhus landed in that country, having escaped from the dangers of an attack by the Mamertines. In passing through the country of the Locri, who had put to death the troops he left behind him, he retaliated by every kind of severity, and supplied his army from the plunder of the temple of Proserpine. The vessels in which he shipped the treasures of this temple were overtaken by a tempest, and every soul on board perished in the waves. The treasure which was cast on shore, he ordered to be collected and replaced in the temple, and he endeavoured to appease the irritated goddess by killing those who had advised him to commit sacrilege against her shrine.

Reinforcing his army by his Italian auxiliaries, Pyrrhus was soon opposed to two Roman armies, under the consuls Curius Dentatus and Cornelius Lentulus. Having repulsed the vanguard of Pyrrhus, Dentatus drew up his army in the Taurasian fields, and gave battle to the enemy. The narrowness of the plain was unfavourable to the large army of Pyrrhus, and though one of his wings began to give way, yet that which he commanded drove back the Romans to their entrenchments by the aid of the armed elephants. Curius immediately ordered a corps of reserve to attack the elephants with torches in one hand, and swords in the other, and having put them to flight, the elephants broke into the phalanx of the Epirots and threw their ranks into the utmost confusion. The Romans took 1200 prisoners, and 8 elephants, and the loss of Pyrrhus has been variously stated from 20,000 to 30,000 slain.

Finding it in vain to cope with the Romans, and having been disappointed in his demands of assistance from Greece, Pyrrhus arrived at Acroceraunium in Epirus, after an unsuccessful war of six years in Italy. He, however, left Milo with a strong garrison in Tarentum, and in order to remind him of his duty, he is said to have presented this general with a chain covered with the skin of Nicias.

Thus deserted by their great ally, the Samnites hazarded a general battle with the Romans, but their army was almost exterminated in the engagement; and Rome thus became mistress of almost all Italy.

The reputation of the Romans had now become widely extended. Foreign nations solicited their patronage and aid, and they were thus involved in foreign wars which had nearly proved fatal to their country.

In this way they were involved in a war with Carthage, which lasted twenty-three years, and of which we have given a full account under our article CARTHAGE, vol. V. p. 571.

After the termination of the first Punic war, the Romans reduced the Boii and the Ligurians, two nations of the Gauls who had revolted. They took the islands of Sardinia, Corsica, and Malta; and in consequence of the piratical proceedings of several Illyrian ships, they carried their arms into Illyricum, a kingdom bordering upon Macedon and Epirus.

Teuta, queen of Illyricum, had not only authorised the piracies of her subjects, but had sent troops to besiege the island of Issa in the Adriatic, which the Romans had taken under their protection. Lucius and Caius Coruncanius were sent as ambassadors to Teuta to remonstrate with her on these acts of injustice; but instead of giving them any satisfaction, she caused the ambassadors to be murdered on their return home to Rome. The Romans, who were then threatened by the Gauls, accepted of the offer of Teuta to deliver up the assassins, but the faithless queen forgot her promise, and even sent her fleet to seize the island of Issa.

To revenge these acts of cruelty and perfidy, a fleet of 100 galleys under Fulvius the consul, with an army of 20,000 men, under his colleague Posthumius, set sail for Illyricum. The city and island of Corcyra were given up to them by Demetrias the governor, and Apollonia, one of the keys of Illyricum, was also put into their hands. The submission of the Andyæans, the Parthini, and the Atintanes, and the capture of the principal towns in the interior, induced Posthumius to return to the coast, and to lay siege to Nutria, a place of great strength, which, after much loss, he succeeded in reducing. He captured also forty Illyrian vessels laden with booty, and afterwards drove the Illyrians from the siege of Issa.

Spurius Corvilius and Q. Fabius Maximus, having succeeded to the consulship, Fulvius, in the character of proconsul, took the command of the army in Illyricum. Teuta retired to Rhizon, one of her strongholds, but finding opposition in vain she sued for peace. The Romans, however, refused to treat with her; but they made peace with the young king, on the condition of his paying an annual tribute, and surrendering a part of his dominions.

The progress of the Carthaginians in Spain, and various hostile movements among the Gauls, excited great alarm at Rome. In order to meet these extraordinary emergencies, an army of 800,000 men is said to have been raised; but the Gauls, forcing their way through Hetruria, advanced towards Rome. Here they had the good fortune to beat one of the Roman armies, but encountering other two, they were totally defeated with the loss of 50,000 men. The Romans pursued them into Gaul, and laid waste their country; but the breaking out of the plague compelled them to return. A new war, however, broke out, and Insubria and Liguria were reduced to a Roman province.

The second Punic war now commenced, and at first threatened to overwhelm the Roman power; but subsequent events, of which we have given a minute account under CARTHAGE, vol. V. p. 575, led to the destruction of Carthage, and the total subversion of the Carthaginian power.

Roman History.

Our limits will not permit us to follow the Roman arms in their wars in Spain and in Syria. In the conquest of Macedon they experienced considerable difficulties. Philip, the last, but one, of the Macedonian kings, after quarrelling with the Romans, was obliged to enter into an unfavourable treaty with them; but on the accession of his son Perseus, (179, B. C.) the Macedonians renewed the war. The Romans were for the first time called upon to resist the Macedonian phalanx, a square body of 16,000 men, having 1000 men in front, and 16 in depth. Each soldier carried a pike 23 feet long; the pikes of the fifth rank extended beyond the front of the phalanx, and hence the shock of such a body of men was almost irresistible. In their first encounter with the Macedonians, the Romans were defeated with a loss of 2200 men. Perseus did not avail himself of this success, and the war was protracted without any decisive advantage on either side.

B. C. 221.
War with Macedon.
B. C. 171.

Paulus Emilius, a commander of much experience, was now sent to Macedon. Perseus made great preparations to receive him, and resolved to hazard a general engagement. The light troops of the Macedonians charged the Romans with incredible vigour, and did great execution, while the phalanx was engaged with the main body of the Roman infantry. Upon seeing this advantage Emilius is said to have rent his garments, and abandoned himself to despair; when perceiving that the phalanx lost its order in some particular places, he commanded his light troops to charge them at these weak points. By this skilful manœuvre this formidable body was thrown into disorder, and the Macedonian king, followed by his army, sought for safety in flight, after leaving about 20,000 dead on the field. The whole kingdom now submitted to the conquerors. Perseus took refuge in Samothracia, but was at last obliged to surrender to the consul, who carried him in triumph to Rome. The Roman dominion over Macedon was occasionally disturbed by some pretenders to the throne; but the kingdom was finally reduced to a Roman province.

Paulus Emilius sent to Macedon.
B. C. 168.

Defeats the Macedonians, who submit to the Romans.

B. C. 118.

The tranquillity of Rome, which the splendour of her foreign conquests had so long contributed to preserve, was now shaken by an intestine sedition. Tiberius Gracchus, the most accomplished youth in Rome, was equally distinguished by his personal appearance, by his commanding talents, and by his powers of eloquence and persuasion. He had been deeply attached to the interests of the Patricians, both from his own connexions, and from those of his wife, who was the daughter of Appius Claudius, then at the head of the Senate; but having negotiated a disgraceful, though a necessary peace with Numantia, he was condemned, along with all those who had signed it, to be delivered up to the Numantines. The people, however, would not suffer Gracchus to be thus sacrificed; and he himself, stung with indignation at the treatment which he had experienced, resolved to revenge himself upon the Patrician families.

Sedition of Tiberius Gracchus,

Having with this view obtained the tribuneship of the people, he determined to revive the Licinian law, which prevented any citizen from holding more than five hundred acres, and thus to make a direct attack upon the property of the nobles, who, in opposition to this enactment, had kept possession of some extensive

who proposes to revise the Licinian law with modifications.

lands for more than 250 years. Tiberius proposed that those who possessed more than 500 acres should receive payment for the surplus out of the public treasury, that every child might hold 250 acres in his own name, independent of what was held by his father, and that the lands thus released should be divided among the poorer citizens. In these views Gracchus was supported by Mutius Scaevola, the ablest lawyer in Rome, and also by his father-in-law, Appius Claudius, and by P. Crassus, the Pontifex Maximus; but the wealthy Patricians, especially those of the senatorial and equestrian orders, opposed it with the utmost vehemence. The influence and the argument which they brought against it, were powerfully exposed by the eloquence of Gracchus; and when they found themselves unable to make an impression upon the people, they assailed the Tribune with every species of calumny, and are said even to have laid plans for his assassination.

When the people had assembled in the Comitium to decide upon the new law, it was unexpectedly opposed by the tribune Marcus Octavius Caecina, who had been gained over by the Patricians, and who pronounced against it his veto.

At another meeting of the Comitium, the rich continued to put off the vote by carrying away the urns, and a most violent altercation having ensued, two venerable senators, Manlius and Fulvius, threw themselves at the feet of Gracchus, and prevailed upon him to refer the question to the conscript fathers.

The Licinian law passed in its worst form.

This uproar, however, as might have been expected, was vain. The Senate resisted the law, and Gracchus was again obliged to appeal to the people. The obstinacy of his colleague, Octavius, rendered this appeal unavailing; and Gracchus and the people had no other resource than to depose Octavius from the tribuneship; and when this was accomplised, the Licinian law was passed in its original and unmodified condition, without any of those clauses by which Gracchus had hoped to render it palatable to the Patricians.

In order to carry this law into effect, Tiberius Gracchus, along with his brother Caius, and his father-in-law, Appius Claudius, were appointed triumvirs. They accordingly travelled through the Italian provinces, to inspect the state of property; but finding that their principal agent had been poisoned in their absence, they caused to be added to the law the new and more obnoxious clause, that the triumvirs should take cognizance of the lands that had been usurped from the republic.

B. C. 133.

About this time, Attalus, king of Pergamus, had bequeathed to Rome his dominions and his treasures. The treasures had actually arrived in Rome, and Gracchus availed himself of his private influence to pass a law, in virtue of which they should be divided among the Roman citizens, who were not likely to receive any of the surplus lands taken from the Patricians. This act of popularity gave him almost absolute command of the voice of the people; and feeling the strength of his influence, he laid a plan of making his father-in-law consul, his brother tribune, and of being himself continued another year in the tribuneship. In order to secure the last of these objects, he gave out that the mob intended to assassinate him, and that his life could only be preserved by the protection which the sacred nature of that office afforded him.

This extraordinary request the people were willing to grant, though the senators resisted it with all their influence. The people watched the house of Gracchus by day and night, in order to save a life which they deemed so valuable. The senators, however, conspired against him, and had determined to get rid of so turbulent an enemy. Mutius Scævola, the consul, refused to arm his legions against the people, in consequence of which Scipio Nasica exclaimed, "Since we are betrayed by our consul, let the friends of the republic follow us." Quitting the temple along with numbers of the senators, he was joined by the friends of the Patricians, armed with staves. Nasica at length came up with Gracchus, who, in his anxiety to escape, made a false step and fell down; but, in attempting to rise, he received a blow upon his head, and his enemies taking advantage of the accident, rushed in and put an end to his life. About 300 of his friends fell in this ferment, and their bodies, along with that of the tribune, were thrown into the Tiber. The rest of his abettors were either slain or banished, and Caius Billius, one of his most staunch adherents, was enclosed in a cask, along with snakes and vipers, where he was allowed to perish. The Senate acquitted Nasica and his assistants, and justified by a decree the cruelties which had on this occasion been exercised.

There is no page of history more deeply instructive than that which records the life of Gracchus. That the public measures which he endeavoured with so much violence to carry, were, to a certain degree, wise and just cannot be denied; that the motives from which he pursued them, and the objects at which he aimed were selfish and detestable, may with equal truth be affirmed. A good cause does not necessarily demand the support of the disinterested patriot. What is in itself excellent, may be rendered noxious by the motives and character of those who pursue it. However devious be the track of ambition, and however baneful its final object, its closest associations are often with wisdom and virtue, and its immediate purposes are often those of benevolence and public good.

A revolt of the slaves in Italy suspended for a while the animosities between the Plebeians and the Patricians. The Licinian, or the Sempronian law, as it was now called, was soon brought forward by the people. Scipio Africanus, the younger, had not only opposed this law with all his influence; but he had gone so far as to declare that the murder of his brother-in-law, Tiberius Gracchus, was lawful. The popularity which he had acquired by his valour was soon lost, and the people even went so far as to insult him in public. His election to the dictatorship was considered as necessary to the peace of Rome; but, on the morning of the day on which this honour would have been conferred, he was found dead in his bed, with marks of having been slaughtered; and it has been supposed that this flagrant act was committed by the triumvirs Papirius Carbo, C. Gracchus, and Fulvius Flaccus, whom his own wife, Sempronia, had admitted into his apartment. The Roman people attended his funeral with cries and lamentations, but no inquiries were instituted concerning his death.

Caius Gracchus was not content with reviving the Sempronian law; he proposed the new one of granting the privileges of Roman citizens to all the Italian allies to whom the grants of land could be given under the Sempronian law. The flame of discontent was thus spread through all Italy, and the enemies of Rome availed themselves of the distractions which it excited, The Senate, however, could not longer brook the attempts which Gracchus had made against their order. The Senate offered their weight in gold for the heads of Gracchus and Fulvius. Gracchus fled to the Temple of Diana, where he was murdered, and his body, along with that of Fulvius, thrown into the Tiber.

These intestine commotions, fermented by the ambition of demagogues, and in which no Roman patriot was concerned, were unexpectedly checked by a horde of barbarians from the north of Europe.

The Cimbri and Teutones, who inhabited the southern shores of the Baltic, left their own country in search of more genial settlements. Being repulsed by the Boii, a tribe of Gauls who lived near the Hercynian forest, they were thus driven towards the Roman provinces. The consul, Papirius Carbo, advanced against them with a powerful army, but he sustained a signal defeat, and was obliged to seek for shelter in the neighbouring forests. The victorious Cimbri carried their devastations into Transalpine Gaul, and after remaining there five or six years, they defeated another Roman army under the Consul Silanus. The Roman empire was now threatened with total destruction, and a new army was sent out under the Consul Mallius, and the Proconsul S. Caepio. In consequence of a quarrel between these two generals, they divided their army, and thus exposed it to the most imminent danger. A detachment of Mallius' army was cut off by the Cimbri; and as soon as the disunion between the two generals became known to their enemies, it was resolved that the camp of Cæpio should be attacked by the Cimbri, and that of Mallius by the Gauls. In both these attacks the assailants were successful, and no fewer than 80,000 of the citizens and allies of Rome, with 40,000 attendants, perished in these unfortunate engagements; and it is said that only ten men and the two generals themselves were left to carry the sad intelligence to Rome. The Cimbri destroyed all their spoil, threw the gold and silver into the Rhone, drowned the horses of the Romans, and put to death all the prisoners. The consternation which this terrible overthrow occasioned, called forth all the energies of Rome. Every citizen capable of bearing arms was called into the field, fencing-masters were introduced into the Roman camp, and a powerful army was quickly raised, and placed under the command of the celebrated Marius. The first object of the Roman general was to meet the Ambrones and Teutones, who were marching into Italy over the western Alps. Having fallen in with this immense army, he defeated them with great slaughter, and is said to have left dead on the field no fewer than 100,000, whose bones were used to fence the vineyards of the peasantry.

The Cimbri had by this time entered Italy. The troops of Catullus and Sylla, intimidated by their terrible aspect, fled before them; and had the barbarians not waited for the arrival of the Teutones they might have easily taken possession of Rome. By this delay Marius had time to unite his forces with those of Catullus and Sylla, of which he received the chief command. This little army of 52,300 men, did not hesitate to attack the Cimbri, who, when drawn up in a square, are said to have extended over thirty furlongs. The Cimbri had tied themselves together with cords fastened to their belts, to prevent them from flying. The Romans soon threw them into disorder, and, unable to quit one another, they were butchered in such crowds, that 120,000 were left on the field. Having taken 60,000 prisoners, the Romans had to contend with the Cimbrian women, who defended their camp with the utmost ferocity and valour.

No sooner was Rome delivered from this swarm of barbarians, than she began to suffer from her own domestic commotions. Marius, embracing the cause of the Plebeian faction, associated himself with Apuleius and Glaucia: An open rebellion took place, and tranquillity was not restored till Apuleius and Glaucia, with a number of their adherents, were massacred.

The privileges of a Roman citizen having been used by many of the Italians in Rome, and a considerable preponderance thus given to the popular faction, a law was passed which compelled all those pretended citizens to quit Rome. The Italian states resented this hasty step, and the Marsi, Samnites, Campanians, and Lucanians, &c. revolted from Rome, and formed themselves into a republic.

Social War.

In this manner arose the Social war, in which the Romans were defeated in almost every engagement. In order to divide their enemies, a law was enacted by which all the Italian states, whose alliance with Rome was unquestionable, should be entitled to the privileges of Roman citizens. Several of the allied powers were thus detached from the general cause; and the command of the Roman armies having been intrusted to Sylla, the Social war was speedily brought to a conclusion.

Civil war between Marius and Sylla. B. C. 89.

That union of parties which one common danger generally effects, never fails to be dissolved on the restoration of tranquillity. Marius and Sylla, who had fought bravely in the same ranks, were now opposed to each other as political rivals, the former supported by the plebeian, and the latter by the patrician interest. In conjunction with the tribune Sulpitius, Marius excited such disturbances, that Sylla was forced to retire from Rome. Marius was now appointed general against Mithridates king of Pontus; but the soldiers refused to march under any other leader than Sylla, and a civil war immediately took place. Sylla entered Rome sword in hand, Marius was forced to retire; and a reward was offered for his head and for that of Sulpitius, and several of their adherents. Sulpitius was seized, and put to death. Marius made his escape; and such was the cruelty with which Sylla exercised the power which he now obtained, that he made himself odious to the senate as well as to the people. Cinna, a violent abettor of the interests of Marius, being chosen consul, summoned Sylla to answer for his cruelties. Sylla, however, thought it prudent to march for Asia, and left his country enveloped in the flames of discord which he had contributed to raise.

Marius was now recalled from Africa, and having landed in Italy, he was joined by numbers of slaves, and men of ruined fortunes, who soon composed a formidable army. Cinna, whom the senate had expelled from Rome, raised another army among the Italian states. Sertorius headed a third army, and, as their adherents daily increased, a fourth army was put under the command of Papirius Carbo. The senate, after making an idle attempt at resistance, was obliged to open the gates to the combined troops. A guard of slaves, organised by Marius for the purposes of revenge, received orders to assassinate all whose salutes he did not return; and these bloody commands were executed to a great extent. Thus privileged to murder, these wretches abandoned themselves to every kind of vice, and Cinna and Sertorius found it necessary to put them all to the sword. The four chiefs, with the exception of Sertorius, entered into a resolution to butcher all the senators who were obnoxious to the popular faction. A general slaughter now commenced. The heads of the murdered senators were stuck upon poles, and their bodies, dragged into the forum, were left a prey to the dogs. Sylla was declared an enemy to his country, and his house demolished.

After desolating Rome, the soldiers of Marius dispersed themselves over the neighbouring towns and villages, and committed acts of cruelty and murder which have not been exceeded in the blackest periods of history.

Successes of Sylla.

While Rome was suffering under these cruelties, Sylla was waging a successful war against Mithridates. After landing in Attica with only five legions and a few cohorts, he speedily made himself master of the capital. The united armies of Archelaus and Taxiles, amounting to 120,000, encountered Sylla near Cheronea with only 15,000 foot and 1500 horse; but such was the bravery of the Romans, that they totally defeated the Asiatic army, and left 110,000 dead on the field.

Dreading the influence which Sylla's success might procure him, the senate sent Lucius Valerius Flaccus the consul, accompanied by Fimbria, an experienced general, and two legions, to attack Mithridates, and to turn their arms against Sylla if they found him disaffected to the senate. In the mean time Sylla, who was in Bœotia, came up with a large Asiatic army under Dorylaus, the king's favourite, over which he gained two victories, in the first of which Dorylaus lost 150,000 men, and in the second the remnant of his fine army. In the last of these engagements, 20,000 were driven into a river where they perished, and a similar number were cut to pieces in a marsh. Plutarch informs us that the marshes were dyed with blood; that the course of the river was stopped by the bodies of the slain; and that in his own day, about 200 years after the battle, numbers of swords, bows, helmets, and coats of mail, were found buried in the sand. Archelaus himself is said to have lain three days stripped among the slain, till he obtained a small vessel to convey him to Eubœa. In consequence of Sylla having bestowed upon that general 10,000 acres of ground near Chalcis, a suspicion arose that he had betrayed his master; but Dio, and Sylla himself in his *Commentaries*, have cleared the name of Archelaus from this odious imputation.

Flaccus killed by Fimbria.

In consequence of some differences between Flaccus and Fimbria, the latter, who had gained over the soldiers, attacked his colleague, and having put him to death, took the command of the Roman armies in Asia. A battle soon took place between his troops and a numerous army of Mithridates, and, after fighting with equality of success, the Asiatic army withdrew to the opposite side of the river to entrench themselves. A violent storm having soon after arisen, Fimbria seized the opportunity which it gave him, crossed the river, and, surprising them in their tents, he made such havoc among them that only the generals and a few troops of horse escaped. Mithridates, the king's son, fled to Pergamus, where his father resided; but Fimbria pursuing him day and night, entered Pergamus sword in hand. Mithridates and his son having fled only a few hours before, Fimbria followed them to Pitane, which he invested. Having no ships to blockade it by sea, he ordered Lucullus, the Roman admiral, to hasten to Pitane with his fleet; but, under the influence of private pique, he refused to come, and thus permitted Mithridates to escape in his fleet to Mitylene.

Most of the Asiatic cities yielded to the arms of Fimbria; and Mithridates's fleet was entirely defeated in two engagements by Lucullus. The king of Pontus, therefore, sued for peace, which Sylla concluded favourably for his country.

Having subdued the common enemy, Sylla turned his arms against his rival Fimbria. Unable to defend himself by force, Fimbria laid a plot for murdering Sylla; but the scheme failing, he put an end to his existence. Thus freed from all his enemies in Asia, Sylla imposed inordinate exactions upon the nations who had resisted his arms, and, having collected immense treasure, he set sail for Italy, leaving behind him Lucullus as quæstor, and Muræna as prætor.

Previous to his departure from Asia, Sylla transmitted to the senate a full account of his victories, and announced his resolution of returning to Rome to take revenge upon his enemies. This letter spread terror through the Roman states. Marius, dreading the encounter, abandoned himself to excessive drinking, of which he died.

The senate organised an army under Valerius Flaccus, but they all deserted to Sylla; and no sooner had Cinna declared himself consul, and assumed Papirius Carbo for his colleague, than the Romans, fearing the misgovernment of their tyrants, flocked in crowds to the standard of Sylla. The senate, indeed, attempted to make an appeal to the compassion of the conqueror; but Sylla persisted in the declaration, that his enemies should perish either by the sword or by the axes of the executioners; and, though numerous armies were raised against him, yet he was everywhere victorious. Cinna fell in a tumult; and the younger Marius, after being defeated, and flying to Præneste, was closely besieged in that city.

In the midst of this civil war, Pontius Telesinus, an experienced general of the Samnites, marched with an army of 40,000 men, under the pretence of relieving Marius. Having thus drawn Sylla and Pompey from Rome, he made a rapid march in the night towards the capital, and arrived at day-break within ten furlongs of the city. Here he avowed his design of destroying every Roman to whatever faction he belonged. The Roman citizens sustained great loss in a sally which they made, and Sylla himself was driven back to his camp. Rome was now on the verge of ruin. Telesinus advanced to destroy her; but Crassus having defeated the other wing of his army, fell upon Telesinus's army, put them to the rout, and saved his country.

The power of Sylla was now predominant. Marching through Atemnæ, he carried 8000 prisoners to Rome, who were at once massacred in the circus. Twelve thousand of the Prænestines suffered the same fate; and the inhabitants of Norba, in Campania, set fire to their houses, and perished in the flames. The streets of Rome were literally filled with dead bodies; and when a senator ventured to ask the tyrant when he meant to cease from his cruelties, he answered with great coolness that he would take the question into his consideration. No fewer than 4700 of the most wealthy and eminent men in Rome were slaughtered by the orders of Sylla; and when he had thus satiated himself with the blood of his enemies, he caused himself to be proclaimed perpetual dictator.

Being now absolute sovereign of Rome, Sylla abrogated every law that stood in the way of his ambitious purposes, and enacted others to sanction the objects he had in view. To the surprise, however, both of his friends and of his enemies, he resigned the dictatorship, and retired to a villa at Puteoli, where he spent the rest of his days in the society of licentious persons, and in the occasional pursuits of literature. His intemperance hastened his death, which took place in the 60th year of his age. The public honoured him with a magnificent funeral, and a monument, with an inscription written by himself, was erected to his memory in the field of Mars.

About this time, Cæsar and Pompey, who had been long distinguished by their military achievements, began that career of rivalry and ambition which proved so fatal to their country. After the death of Marius and Cinna, Sertorius fled to Spain, where he established an independent republic. Pompey and Metellus, who were sent against him, were defeated in every battle, and, though the best generals of the age, they were compelled to abandon their enterprise against him. The officers of Sertorius, however, jealous of his fame, conspired against him. At a public banquet, Perpenna overturned a glass of wine as a signal to the conspirators, and immediately Antonius, another officer, stabbed the aged general to the heart. Destitute of talents, the conspirators were unable to supply the place of their former leader; and Pompey put a speedy termination to the Spanish war.

The tranquillity of the republic was now disturbed by Spartacus, a Thracian shepherd, who was one of the gladiators kept at Capua, in the house of Lentulus. Escaping from his confinement with thirty of his companions, he took up arms against the Romans. At the head of 10,000 men he laid waste the country, hiding himself at first in the solitary regions of Campania; but as his army increased in numbers, and improved in discipline, he engaged the Romans in open battle, and defeated with great loss two consuls that were sent against him. Crassus was next placed at the head of a powerful army, and though he at first despaired of success, yet he at last succeeded in defeating Spartacus in a bloody engagement, and putting 12,000 of the slaves to the sword. Spartacus displayed great personal valour in this encounter. When wounded in the leg he fought on his knees, wielding his sword in the one hand, and shielding himself with his buckler in the other; and when he was overpowered by an irresistible force, he breathed his last above a heap of Romans who had fallen beneath his sword. A part of the army of Spartacus, however, rallied after their defeat, and, being routed by Pompey, this ambitious leader claimed too great a portion of the glory which was due to Crassus.

Pompey was now chosen consul along with Crassus; and it soon became evident that the commonwealth was to suffer from the ambition of these two rivals. After they had with difficulty been made to lay down their arms, they entered into a contest for popular favour. Pompey attempted to ingratiate himself with the people, by reinstating the tribunes in their rights, of which Sylla had deprived them. Crassus, who was the richest man in Rome, and whose property exceeded considerably a million of English money, entertained the populace in the most liberal manner at 10,000 tables, and distributed among them corn sufficient to serve their families for three months.

With the view of putting down the numerous piracies which prevailed, Pompey received absolute authority for three years over all the isles within the Pillars of Hercules, and over all the countries 400 furlongs from the sea. He was authorised to raise soldiers and sailors, to take the necessary sums out of the public treasury without being accountable for them, and to select fifteen senators as his lieutenants. The tribune Roscius attempted in vain to resist this grant of power and of money. The law was passed, and Pompey executed the duties of his office to the satisfaction of his country. Without resigning his sovereignty of the seas, he was nominated general of all the forces in Asia, by a law which was supported by Cæsar and by Cicero. This great charge he executed with the highest success, and completed the conquest of Pontus and other eastern countries.

Catiline's conspiracy.
B. C. 64.

Rome was at this time nearly destroyed by the conspiracy of Catiline, to which it has been said that both Cæsar and Crassus were privy. The history of the conspiracy, and an account of the defeat and death of Catiline, have already been given under our article CATILINE.

In the absence of Pompey, Cæsar rose rapidily in favour with the people. In the year of Catiline's conspiracy, he was chosen Pontifex Maximus. He was next advanced to the prætorship, and, when this office expired, he was appointed by lot to the government of Lusitania. Having subdued several nations in Spain that had not before been subject to Rome, Cæsar publicly claimed a triumph. Ambitious, however, of the consulship, he waved his pretensions to the triumph, and entered Rome.

Triumvirate of Cæsar, Pompey, and Crassus.
B. C. 60.

Here he found Pompey and Crassus struggling for popularity and power. Under the mask of friendship for both, he proposed to them to forget their differences, to unite their interests, and to form a triumvirate, in which the whole power of the senate and the people should be centred in Pompey, Crassus, and Cæsar. This secret league was soon formed and ratified by mutual oaths. Through the influence of his colleagues, Cæsar was raised to the consulship, and, in order to root himself more deeply in the affections of the people, he passed the Agrarian law, by which a provision was to be made for 20,000 of the poorer citizens. To secure the influence of the knights, he abated a third part of the rents which they annually paid into the treasury, and he was thus able during the rest of his consulship to govern Rome with the most despotic sway. The influence of Pompey, however, stood in the way of Cæsar's ambition. A strong military force was necessary to the accomplishment of his schemes, and, through the influence of his friends, he was appointed proconsul of Cisalpine and Transalpine Gaul for a period of five years, and with an army of four legions. During this period he carried on eight campaigns in Gaul, and made two descents on Britain, a full account of which he has left behind him in his *Commentaries;* and he thus gained the two great objects of his ambition, the highest military renown, and a victorious army devoted to his cause.

Pompey and Crassus having been raised to the consulship, waited on Cæsar at Lucca, where they arranged their new schemes of mutual ambition. It was stipulated between them, that Crassus was to have the government of Syria and the eastern provinces; that Pompey was to govern Spain and Africa; while Cæsar was contented with the continuance of his command in Gaul for other five years.

The Romans under Crassus surrender to the Parthians.
B. C. 53.

Crassus having undertaken an expedition against the Parthians, he was met in an extensive plain by the Parthian army under Surena, by whom he was defeated with a loss of 20,000 killed, and 10,000 prisoners. Crassus and the rest of his army escaped by the darkness of the night; but the mutiny of his soldiers, and the treachery of his guides, compelled him to surrender himself to the Parthian general, who cut off his

B. C. 53.

head, and sent it to the king Orodes. In consequence of this event Cæsar and Pompey were left the sole arbiters of the fate of Rome.

When Cæsar had succeeded in subjugating Gaul, it was resolved by the senate that both he and Pompey should disband their armies; but the designs of Cæsar having become more obvious to his countrymen, a decree of the senate was passed, ordering the consuls, the proconsul Pompey, the prætors, and all who had been consuls, to provide by every means in their power for the public safety. When this decree for a civil war was passed, the consuls Marcellus and Lentulus presented Pompey with a sword, requiring him to defend the republic, and to command their armies. Lucius Domitius was appointed to succeed Cæsar, and the most active preparations were made by the senate for defending their country. Cæsar, however, determined to commence hostilities. With one of his legions he surprised and made himself master of Ariminium; and he sent immediate orders to the powerful army which he had left in Gaul to join him without delay.

Success of Cæsar.

Alarmed at the unexpected activity of Cæsar, Pompey retired to Capua. In the mean time Cæsar was busy raising fresh troops; and his own army, and that which he placed under Mark Antony, took possession of several towns in Italy. Corsinium having been reduced, Pompey retreated from Capua to Brundusium, which was immediately invested by Cæsar; but before he had completed his contrivance for shutting up the harbour, the fleet had carried the two consuls and thirty cohorts to Dyrrachium. Pompey having thus the means of escape in his power, masked his designs, by walling up the gates, digging ditches in the streets, and making every preparation for withstanding a siege. He placed his light infantry on the walls, and commanding the citizens to keep within doors, he embarked all his troops in the space of three days, and giving a signal for the light troops to follow, they repaired in haste to the ships. No sooner did Cæsar observe that the walls were unguarded, than he ordered them to be scaled; but before his troops could reach the harbour he found Pompey's fleet in full sail, with the exception of two ships which had run aground in the hurry of quitting the harbour.

Flight of Pompey. B. C. 50.

Cæsar advances to Rome.

Being thus left in the peaceful possession of all Italy, Cæsar advanced to Rome, where he conducted himself with that moderation and humanity which he thought most likely to gain his object. Quartering his troops in the neighbouring municipia, he took up his own residence in the suburbs, where, through his friends Mark Antony and Cassius, he requested the senate to receive a justification of his conduct. At the conclusion of the speech which he made on this occasion, he proposed to offer terms of accommodation to Pompey; and he even requested some of the conscript fathers to carry pacific terms to the consuls. Having thus ingratiated himself even with those who were not of his party, he applied for money from the public treasury. On the authority of a law, Metellus, one of the tribunes, opposed this demand; but Cæsar, disregarding his opposition, went to the temple of Saturn, where the public money was kept, broke open the doors, and took from it the enormous sum of 300,000 pounds weight of gold.

Cæsar takes money from the public treasury.

With such a liberal supply, Cæsar raised troops over all Italy, and sent governors into the different provinces: to Mark Antony he gave the command of the armies in Italy; to his brother C. Antonius, the government of Illyricum; and to Licinius Crassus, that of Cisalpine Gaul. He gave the charge of the capital to Æmilius Lepidus, and he set over his fleets P. Cornelius Dolabella, and the younger Hortensius. As Pompey had placed governors over the same provinces, the flames of a civil war raged in almost every part of the world.

After settling his affairs at Rome, Cæsar hastened to Spain; but when he arrived in Transalpine Gaul, he found that Lucius Domitius Ahenobarbus had arrived at Marseilles with a squadron of seven galleys, and had taken possession of the city in the name of Pompey. He therefore built twelve galleys at Arles, and invested Marseilles with those legions which he left under the care of C. Trebonius. He likewise sent forward Q. Fabius with three legions, to take possession of the Pyrenees, and immediately followed him with the rest of his army. Having learned on his arrival that Africanus and Petreius had posted, on a hill near Lerida, their combined forces, consisting of 5 legions, 20 native cohorts, and 5000 horse, Cæsar encamped in a plain between the Segro and Cinca, and attempted to seize a small eminence between the enemy's camp and Lerida, from which they derived their provisions. After a severe conflict, which continued five hours, Africanus maintained his position. The failure of Cæsar in the first action, was followed by calamities of the most distressing kind. From the swelling of the rivers and continued rains, the two rivers, between which Cæsar had encamped, swelled to such a degree that they broke down all his bridges, and inundated the neighbouring country. By this accident he could no longer receive supplies from the cities that had declared for him; and though he attempted to rebuild his bridges, yet the force of the current would not permit it, and his army was on the eve of perishing with want.

The adherents of Pompey in Rome began to show their opinions when the intelligence of Cæsar's distresses reached the capitol. Even Cicero, whom Cæsar himself had requested to remain neutral, set off for Dyrrachium, where Pompey received him in the most friendly manner.

The distress of Cæsar, however, was only temporary. The resources of his great mind increased with his calamities, and when he found it in vain to erect his bridges, he built a number of boats with singular expedition; and while Africanus was attempting to intercept the succours sent him from Gaul, he conveyed his boats during the night on carriages to a distance of twenty-two miles, when a large detachment passed the Segro, and pitching their camp on the opposite bank, erected a bridge in two days, and, saving the supplies from Gaul, relieved the necessities of the army. Thus preserved from the horrors of famine, Cæsar pursued the armies of Africanus and Petreius, and without coming to a general engagement, he forced them to lay down their arms, and thus possessed himself of all southern Spain. Varro, who commanded in farther Spain, followed the example of Africanus, and left Cæsar in the quiet possession of the whole kingdom.

Leaving Cassius with the legions as governor of Spain, Cæsar returned to Rome by the way of Marseilles, which he found on the eve of surrendering to Trebonius. Upon his arrival in Rome, M. Æmilius Lepidus, one of the prætors, in opposition to the wishes of the Senate, nominated Cæsar dictator, an office which he immediately accepted. During the eleven days which he held that office, he acquired by his moderation the affection of all classes. He recalled those who were banished, and conferred the rights of Roman citizens on all the Gauls beyond the Po. As dictator he presided at the election of the consuls, and resigning that office, he and Servilius Isauricus, one of his best friends, were elected consuls for the next year.

Determined to carry his arms into the east, he sent twelve legions to Brundusium. In the beginning of the year he arrived with five legions and 600 horse, in Chaonia in Epirus, and sent back two ships to bring over the rest of his army. Pompey was equally active in marshalling his forces; and had received reinforcements of extraordinary magnitude both from Europe and from Asia. He had obtained one legion from Sicily, one from Crete, and two from Syria. The princes in alliance with Rome raised three thousand archers, six cohorts of slingers, and seven thousand horse. The free Asiatic cities joined him with their best troops; and he is said to have received succours from Arabia and Ethiopia, and even from the Indus and the Ganges. His own army comprehended almost all the Roman knights, and the flower of the young nobility; and his soldiers were principally veterans, accustomed to all the dangers and privations of war. His fleet consisted of about 500 ships, and his army was accompanied by the two consuls of the last year, and about 200 Roman senators. The cause of Pompey was therefore everywhere considered as the cause of the Roman commonwealth. Those who had hitherto remained neutral flocked to his standard; and all who were distinguished by their patriotism and their virtues had taken refuge in his camp. When Cæsar had landed in Epirus, he took Oricum and Cephalonia; and he was on the eve of marching to Dyrrhachium, which contained Pompey's magazines, when he heard that thirty of the ships which he had sent back to Brundusium had been taken by Bibulus, one of Pompey's admirals, and that his troops at Brundusium were likely to fall into the hands of the enemy, who possessed all the harbours between Salonium and Oricum. Under these circumstances, Cæsar offered to make peace with Pompey, on the conditions that the armies of both should be disbanded in three days; that their former friendship should be solemnly renewed, and that they should return together into Italy. These terms were twice sent to Pompey, who refused to enter into any accommodation. Cæsar therefore advanced towards Dyrrhachium; but Pompey having entrenched himself in its immediate neighbourhood, he was disappointed in his expectations of taking it by surprise. The two hostile armies were unwilling to engage; and Cæsar, who was sensible of his great inferiority in numbers, sent the most urgent dispatches to Mark Antony to hasten to his assistance. Having received no reply to these demands, he disguised himself in the habit of a slave, and resolved, in the frail bark of a fisherman, to cross over to Brundusiun, through the enemy's fleet; but the boat being driven back by contrary winds, he dispatched Posthumius with the most urgent orders to Mark Antony to bring over the troops at every hazard. These succours at last arrived under Mark Antony and Calenus, who landed them safely at Nyphœum. Pompey attempted in vain to prevent their junction with the main army, and no sooner had Cæsar collected his forces than he offered Pompey battle, and drew up his army in his sight. Pompey, however, declined the engagement, and encamping on a hill called Petra, which commanded the sea, he expected to be supplied with provisions from Greece and Asia, while his rival would be reduced to the necessity of procuring them from Epirus by a dangerous and expensive route.

Cæsar, who saw his design, conceived the bold plan of besieging Pompey in his camp. He drew round it a line of circumvallation, and hemmed in Pompey so completely, that his horses died for want of forage, though his troops were liberally provided for by sea. Cæsar's army suffered great distress for want of corn, but those of his men who had been in Sardinia made bread from an herb called *clæra*, which they steeped in milk. The diseases which broke out in Pompey's camp, and the want of forage, forced him to break through the line of the enemy. Embarking his archers, slingers, and light infantry, he marched at the head of sixty cohorts to attack the part of Cæsar's lines next the sea that were incomplete. The seventh legion who defended them gave way; and notwithstanding the succours that were sent by Marcellinus, Pompey was successful till a powerful body of troops under Mark Antony compelled him to retire. Cæsar now attempted to seize a post occupied by a legion of Pompey's troops. He accordingly attacked it with thirty-three cohorts, and in spite of the most powerful resistance, penetrated to the second entrenchment. Cæsar's right wing, however, mistook the entrance into the camp, and having separated from the left wing, were thrown into great disorder, which Pompey no sooner perceived, than he attacked them with his cavalry and completed the defeat. Cæsar attempted in vain to rally his routed soldiers, who left thirty-two Roman eagles in the hands of the enemy.

Cæsar defeated in his attack on Pompey's camp.

Mortified, but not disheartened by this severe defeat, Cæsar addressed his army with the most soothing eloquence, and retired to Apollonia. He thence marched to Macedon, with the view either of drawing Pompey into a general engagement, or of cutting off Scipio Metellus, Pompey's father-in-law. The news of his late defeat threw immense obstructions in his way; but having marched into Thessaly, the principal towns opened their gates to him.

The dilatory conduct of Pompey, though no doubt founded on true wisdom, and on a thorough knowledge of the talents and situation of Cæsar, began to give umbrage to his own officers; and under the influence of these feelings, which had extended themselves even to the common soldiers, he resolved upon risking a general battle. With that view, he occupied the wide plain of Pharsalia between Pharsalus and Philippi, where he was joined by his father-in-law Metellus.

Pompey resolves to give battle to Cæsar.

Pompey pitched his camp on the declivity of a mountain which was entirely inaccessible; but he was deeply impressed with the propriety of destroying his enemy by the slow weapons of fatigue and hunger, rather than staking his whole fortune on the issue of an engagement with a brave and almost desperate army. He therefore availed himself of various pretences to evade an action, till he was compelled to it by the unanimous decision of a council of war, which his officers had almost forced him to assemble. Having determined to offer Pompey battle, Cæsar led out his army; but Pompey still kept his advantageous position under the cover of his trenches at the foot of the hill. Unwilling to attack his enemy in such a position, Cæsar resolved to decamp next day, and had just struck his

Battle of Pharsalia.

Battle of Pharsalia.

tents when he learned that Pompey had quitted his entrenchments and advanced into the plain. He immediately halted his army, and drew them up in order of battle. The army of Cæsar did not exceed 22,000 foot and 5000 horse, while that of Pompey was above 45,000 foot and 7000 horse. In order to make up for this inequality in his cavalry, Cæsar had selected the strongest and the most active of his foot soldiers, and taught them to fight between the ranks of his cavalry. Pompey placed his veteran troops in the centre and two flanks of his army, and he distributed his new levies over the main body of the army. Scipio commanded the Syrian legions in the centre, Domitius Ahenobarbus led the Spaniards on the right wing, which was covered by the river Cnipus, while Pompey placed himself at the head of two legions on the left, where he had assembled all his horse, slingers, and archers, with the view of making the most vigorous attack from that quarter.

Cæsar's army was divided into three bodies. Domitius Calvinus commanded the centre, Mark Antony the left, and Cæsar the right wing, which was to be opposed to Pompey, and which consisted of his favourite tenth legion. The appearance of Pompey's cavalry in one spot, indicated to Cæsar the intentions of his rival. He therefore drew six cohorts from his rear, and concealing them behind his right, he instructed them to reserve their javelins till the approach of Pompey's cavalry, and to push them in the faces of the horsemen, who, consisting of the young Roman nobility, dreaded a scar in the face more than the severest wound in the body. He then placed his own handful of cavalry on the right of the tenth legion, and commanded his third line to await his signal.

After encouraging their respective troops, Cæsar gave the signal for battle, and his army advanced, while that of Pompey had been instructed to receive the first shock without quitting their places. While Cæsar's line, advancing boldly to the combat, saw the enemy motionless, they suddenly halted, and during the pause which ensued, the hostile lines gazed at each other with inward horror, but with undisturbed serenity. After having breathed for a while, Cæsar's troops advanced with fury, discharging their javelins, and fighting with their swords. Pompey sustained the attack by similar weapons; but no sooner had he ordered his cavalry to charge, along with the archers and slingers, than Cæsar's men began to give way. The reserve of six cohorts which Cæsar had prepared to resist this attack now advanced, and striking at the faces of their pursuers, produced the complete effect which Cæsar had expected. The young Roman nobility, who valued themselves on their beauty, were intimidated by the unsightly wounds which were inflicted on their companions, considered only how to defend their persons; and being put to the rout, they fled in a most disorderly manner to the mountains, leaving the archers and slingers to be cut to pieces by the enemy. The successful cohorts now advanced against the flank and rear of Pompey's left, which made a brave resistance, till Cæsar's third line attacked them in front, and forced them to fly to their camp. The auxiliaries had fled, while Pompey's right wing was fighting with great bravery; but Cæsar, seeing that the issue of the conflict was no longer doubtful, cried out to his men to pursue the strangers, but to spare the Romans. The auxiliary troops were slaughtered in great numbers; but the Romans laid down their arms, and received quarter. Notwithstanding this great overthrow of his enemy, Cæsar considered his victory as incomplete until he was in possession of Pompey's camp. He therefore marched on foot at the head of his army, and incited them to complete the victory which they had already achieved. The cohorts and the Thracian troops who defended the camp made a bold resistance; but they were driven from the trenches, and forced to take refuge in flight. As a strong body of the fugitives had retired to the mountains, Cæsar thought it necessary to pursue them; and, after various operations, he at last compelled them to surrender. When Cæsar saw the field covered with the bodies of his countrymen, he exclaimed to one who stood near, "They would have it so." He treated the vanquished with great humanity; and the honours which he acquired as a victor were soon rendered more glorious by the attributes of clemency and moderation by which he was ennobled. Cæsar lost about 200 men, and Pompey 15,000. No fewer than 24,000 laid down their arms, and entered into Cæsar's army.

After this unfortunate event Pompey fled, and Cæsar resolved to follow him into whatever country he should fly for refuge. In this pursuit, Cæsar went to Amphipolis, to Ephesus, and from Ephesus to Rhodes, where he learnt that Pompey had retired to Egypt. He therefore set sail without delay and reached Alexandria with about 4000 men; but he had no sooner landed, than he heard of Pompey's assassination by the king of Egypt, and was soon presented by one of the murderers with the head and ring of his great rival. Cæsar turned from the sight with instinctive horror, and subduing the feelings of animosity which he had so long cherished against an inveterate enemy, he ordered a splendid monument to be erected to the memory of Pompey, and he consecrated the spot by building a temple to Nemesis.

Disliking their alliance with the Romans, the Egyptians conceived the design of breaking off their allegiance. Photinus, the eunuch, not only behaved with disrespect to Cæsar, but he even attempted to murder him. Conscious of the inadequacy of his military force, Cæsar checked the resentment which these circumstances had raised; but he sent privately for the Roman legions which were nearest to Egypt. When these reinforcements arrived, Cæsar avowed his intention as Roman consul to settle the succession to the crown of Egypt, which was then contested between Ptolemy and his sister Cleopatra. Although the Roman senate had taken the part of Ptolemy, and had therefore concurred in the banishment of Cleopatra and her sister Arsinoe into Syria, yet Cæsar treated the question as undecided, and commanded Cleopatra and Ptolemy to appear before him to plead their cause. Enraged at this proposal, Photinus, the guardian of Ptolemy, sent an army of 20,000 men to besiege Cæsar in Alexandria. The Egyptians were soon repulsed; but Cæsar finding Alexandria too extensive to be defended by this small army, resolved to make a stand in the palace which commanded the harbour. Achillas, the Egyptian commander, attacked him in this position, and attempted to seize his fleet; but Cæsar set fire to the ships, and having afterwards taken the Isle of Pharos, &c. the key to the harbour, he was abundantly supplied with every thing, and resolved to oppose every attempt on the part of the enemy.

Although Cleopatra had raised an army in Syria, yet she trusted principally to the influence of her personal charms in engaging Cæsar in her cause. As all the avenues to the palace were occupied by the enemy, she got on board a small vessel and landed near the palace, she was wrapped up in a coverlet, and carried by one Aspolodorus into Cæsar's chamber, where she succeeded in interesting him in her cause. Arsinoe, who likewise aspired to the sovereignty, had, through the influence of one Ganymede, her confidant, created a strong interest in the Egyptians. She caused Achillas to be murdered, and giving the command to her favourite, she carried on the siege of Alexandria with renewed vigour. Ganymede gained several advantages over the besieged, and seizing a bridge which joined the Isle of Pharos to the main land, an action ensued, in which the Romans were panic-struck and thrown into confusion. Cæsar retired into a ship, into which he was followed by such crowds, that fearing it would sink, he threw himself into the sea and swam to the fleet before the palace.

As Cæsar had seized upon the young king, the Egyptians employed every kind of artifice to get him into their possession; and pretending a great anxiety for peace, they requested their king to ratify it by his signature. Cæsar saw through their schemes, but surrendered the king, who exerted himself in carrying on the war with new vigour.

Mithridates, king of Pontus, one of Cæsar's faithful allies, had collected a numerous army in Syria for the purpose of relieving Cæsar. He accordingly took Pelusium, and defeating the Egyptians, he joined his forces to those of Cæsar, and then attacking their camp, he put great numbers to the sword. Ptolemy, who had escaped on board a vessel, was drowned by the sinking of the ship; and Cæsar having thus obtained the mastery over his enemies, appointed Cleopatra and her younger brother joint sovereigns of Egypt, and banished Arsinoe and Ganymede from the country.

Seduced by the charms of the Egyptian queen, Cæsar abandoned himself for a while to the dissipations of peace; but when he proposed to accompany Cleopatra to Ethiopia, his brave troops remonstrated against his conduct, and being thus roused to a proper sense of his duty, he tore himself from the spells of his enchantress, and marched against Pharnaces king of Pontus, who had gained some advantages over Cneius Domitius Calvinus governor of Asia.

When Cæsar was approaching to Armenia, Pharnaces attempted to deceive him by offers of peace; but Cæsar understanding his object, appeared very desirous of meeting his views. When Cæsar arrived in Pontus, and had collected his forces, Pharnaces offered him a crown of gold and his daughter in marriage. Cæsar offered him conditions of peace, to which Pharnaces assented; but being dilatory in fulfilling them, Cæsar attacked him unexpectedly in his camp, and defeated him with great loss. Cæsar divided the spoils of his camp among the soldiers, and made Mithridates Pergameus the king of Bosphorus sovereign of Pontus.

Having thus settled the affairs of Pontus, and left Domitius in it with adequate forces, Cæsar returned to Italy, and found Rome agitated by commotions which Mark Antony had given rise to by the riotous and unprincipled life which he led. Cæsar, however, treated all parties with moderation and humanity; and when he had given tranquillity to the capital, and established his own authority, he set out on an expedition to Africa, where Scipio and Cato, aided by Juba king of Mauritania, still supported the cause of Pompey. Cæsar invested the city of Thapsus, and having thus drawn to its relief Scipio and Juba, he brought on a general engagement, in which his enemies were totally overthrown. Juba and his general Petreius slew each other in a fit of distraction, and Scipio was slain in an attempt to escape into Spain. Cato retired to Utica, but finding his adherents unwilling to stand a siege, he stabbed himself with his sword.

Defeats Scipio in Africa.

Cæsar's triumph.

The war in Africa being thus ended, Cæsar returned in triumph to Rome. The splendour of this triumphal procession exceeded every thing that had formerly been seen. The procession continued four days, one for Gaul, one for Egypt, a third for Asia, and a fourth for Africa. Every soldier received about £150, and every citizen ten bushels of corn, ten pounds of oil, and a sum equivalent to £2. The populace were entertained at 20,000 tables, and Rome was crowded with visitors from every part of Italy to witness the celebration of Cæsar's glory.

Cæsar receives the title of Emperor.

The popularity of Cæsar rose to the most unexampled pitch. He received the title of emperor, and father of his people; his person was declared sacred, and every species of incense was offered to this great warrior. Flattering as these marks of favour were to a mind like Cæsar's, there never was a sovereign who used his power with more wisdom and moderation. The first act of his authority was to repress vice, and promote private and public virtue. He restrained the luxuries of the rich by sumptuary laws, and he vested the power of judicature in the senate and the knights. From the midst of these wise regulations he was suddenly called into Spain, to oppose an army under the two sons of Pompey and Labienus. The insurgent leaders endeavoured to protract the war; but Cæsar at last forced them to a battle on the plains of Munda, where, after a desperate and bloody encounter, Pompey was defeated with the loss of 30,000 men.

Cæsar defeats Pompey in Spain. B. C. 45.

Having thus acquired, by the force of his arms, the whole Roman empire, Cæsar returned to Rome the master of the world. He pardoned all who had carried arms against him; he allowed the people to nominate the consuls; he enlarged the number of the senators; and, with his usual liberality, he again set up the statues of Pompey. Besides these acts of moderation and political wisdom, he ornamented Rome with the most magnificent buildings; he rebuilt Carthage and Corinth; and he conceived many noble projects both of a pacific and a military character, which he was not destined to realise.

Conspiracy against Cæsar.

The fresh honours with which the senate continued to load Cæsar, gave rise no doubt to the envies and jealousies of a body of men, who conspired against his life. At a public festival Cæsar had repeatedly refused a diadem, which Mark Antony had offered for his acceptance; and, notwithstanding this, a rumour was widely circulated that he aspired to the name of an office, of which he enjoyed all the splendid realities. Whatever were his designs, he conducted himself in a way which put down every suspicion; and when he was informed of the jealousies of particular individuals, he declared that he would rather die once by treason than live in the continual apprehension of it. He went so far even as to disband his Spanish body guards, and thus to throw himself upon the affections of the Roman people.

Notwithstanding this generous confidence in his enemies, the conspiracy which we have already mentioned became more daring in proportion to the facility of carrying it into execution. No fewer than sixty senators had combined themselves against him; and at the head of this band of pretended patriots stood Brutus and Cassius, the same men whose lives Cæsar had spared after the battle of Pharsalia. The one sought for the equivocal reputation of sacrificing all the ties of friendship and of gratitude to a virtue that assassins never feel; while the other panted for revenge against a superior, whose pre-eminence had mortified his pride, and exasperated his hatred.

The rumour that the crown was to be offered to Cæsar on the ides of March, (which was itself probably the invention of the conspirators,) induced them to fix upon that day for the execution of their designs— and thus to sanction their atrocities by making them appear to be the punishment of a crime which existed only in their own imaginations. Among the fables of Roman superstition, it has been said that the augurs bad predicted that this day would be fatal to Cæsar; and on the night preceding, his wife Calphurnia is reported to have dreamt of his assassination. These unlucky omens are said to have changed his designs of going that day to the senate; but one of the conspirators prevailed upon him to persist in his resolution.

Assassination of Cæsar.

No sooner had Cæsar taken his place in the senate-house, than the conspirators approached near his person. Cimber advanced as a suppliant, to request the remission of a sentence of banishment which had been passed upon his brother. The conspirators seconded this application, and, when Cimber gave the signal by taking hold of the bottom of Cæsar's robe, Casca stabbed him from behind in the shoulder, when Cæsar instantly turned round, and struck him on the arm with the style of his tablet. The conspirators now thronged around him, and he received a wound in the breast, while Cassius stabbed him in the face. In this crisis Cæsar defended himself with vigour, and threw down the opposing conspirators; when on a sudden he saw Brutus among the number, who came up and drove his dagger into his thigh. Astonished at the desertion of his friend, Cæsar uttered the celebrated exclamation, *Et tu Brute*, "and you too, Brutus," and, muffling up his face in his robe, he sank at the base of Pompey's statue pierced with twenty-three wounds.

Conduct of the conspirators.

Having thus accomplished their object, the conspirators attempted to vindicate their conduct before the senate; but though they alleged that they had freed their country of a tyrant, and were actuated by no other motives than a love of freedom, yet the people distrusted their professions; and the conspirators retired for safety to the capitol, the approaches of which Brutus had defended by a body of gladiators.

Though these blood-stained patriots, however, had freed Rome of one whom they considered to be her oppressor, they made no provision for protecting the commonwealth from those ebullitions of popular frenzy which such an event might excite; and they had devised no schemes, and proposed no sacrifices, for preventing other tyrants from starting up from the tomb of Cæsar.

Conduct of Antony and Lepidus.

While the Roman patriots were skulking in the capitol with their daggers at their sides, and under the protection of armed criminals, Antony and Lepidus were straining every nerve to gain the sovereign authority.

Lepidus and Antony took possession of the forum with a band of soldiers, and, after seizing all Cæsar's papers and money, they assembled the senate to determine whether Cæsar was an usurper or a legal magistrate, and what should be the fate of those who slew him. In such a crisis, where their lives and properties were exposed to two infuriated parties, the senate approved of all the acts of Cæsar, and at the same time granted a general pardon to the conspirators.

The conspirators pardoned.

Though dissatisfied with the decree, Antony is said to have induced Cæsar's secretary to alter his will, and insert in it many liberal benefactions to the Roman people. He then demanded that Cæsar's funeral obsequies should be performed; and carrying the body with great pomp and solemnity into the forum, he pronounced a funeral oration, which excited the feelings, and roused against the conspirators the hatred of all who heard it. At the beginning of the oration, Antony read aloud Cæsar's will, in which he left Octavian, his sister's grandson, as his heir; Brutus was to inherit three-fourths of his private fortune. The gardens on the other side of the Tiber were bequeathed to the Roman people, and to every citizen there was left 300 sestercia. After many eloquent appeals to their sympathy, the people cried out for revenge, and, armed with flaming brands from the funeral pile, they ran to set fire to the houses of the conspirators, who found it prudent to retire from the city. Divine honours were then granted to the memory of Cæsar, an altar was erected on the site of the funeral pile; and a monument was afterwards raised on the same spot, and inscribed *To the Father of his Country*. Having thus secured the affections of the people, Antony endeavoured to bring over the senate, and forgetting his vow to revenge the death of Cæsar, his only object was to consolidate that power, which, by a combination of circumstances and expedients, he had contrived to acquire.

Octavius, or Octavianus Cæsar, the grand nephew, and the adopted son of Cæsar, was now at Apollonia where he had been sent to the study of Greek literature. Though only in the 18th year of his age, he resolved to return to Rome to claim the inheritance which Cæsar had bequeathed to him, and to revenge the death of his kinsman and benefactor. From Antony, in whom he expected an ardent abettor, he met with the coldest reception, and, instead of paying him the fortune bequeathed him by Cæsar, he brought forward every pretence for delaying a settlement. In order to pay the legacies which Cæsar had left, particularly the one due to the people, Octavianus sold his own patrimonial estate, and thus gained the highest popularity. Handsome in his personal appearance, insinuating in his address, fluent and well informed in his conversation, and above all, bearing the name of Cæsar, a name dear to the Roman people, Octavianus soon became a favourite, and crowds of his uncle's followers flocked to his standard. He was soon joined by some of the legions of Mark Antony, who cherished the desire, which was universal among the Roman army, to inflict vengeance on the conspirators. From these causes the Roman empire was divided into three parties, that of Octavianus, successor of Cæsar; of Antony, who aimed at absolute power; and of the conspirators, whose avowed object was to restore the rights of the senate.

While Antony was besieging Mutina, in Cisalpine Gaul, into which Brutus had retired with his forces, Octavianus returned to Rome with 10,000 men, and having, through the eloquence of Cicero, attached the senate to his cause, a decree was passed, commanding Antony to raise the siege of Mutina, to evacuate Cisalpine Gaul, and to await on the banks of the Rubicon the farther commands of the senate. As this order was treated with contempt, the two consuls Hirtius and Pansa joined their forces to those of Octavianus. After some battles of no importance they brought Antony to a general engagement, in which he was defeated, and fled for protection to Lepidus, in Farther Gaul. In this battle the two consuls were mortally wounded; and Pansa, having called Octavianus to his death-bed, advised him to join Antony; as the object of the senate was to ruin both. Perplexed with this advice, and being soon after refused a triumph, Octavianus resolved to join Antony and Lepidus; and this resolution was fixed by their refusing him the consulship. Antony and Lepidus cheerfully agreed to the scheme suggested by Pansa, and crossing the Alps at the head of an army of seventeen legions, they threatened destruction to all who opposed them.

Discovering the error which they had committed, the senate now elected Octavianus consul, and held out to him the prospect of new honours. By means of this newly acquired influence, he obtained a law for the condemnation of Brutus and Cassius, and then he united his army with that of Antony.

At a conference, which lasted for three days, Octavianus, Antony, and Lepidus established themselves into a triumvirate for five years, during which Octavianus should have Africa and the Mediterranean, Antony Gaul, and Lepidus Spain. They agreed that their enemies should be destroyed; and in the lists which they gave in, were comprehended the names even of the friends of the triumvirs. Above 300 senators, among whom were Cicero, Paulus the brother of Lepidus, and Lucius, the uncle of Antony, and above 2000 knights, were included in the fatal list, and their estates divided among their murderers. In consequence of these cruelties many Romans fled to the army of Brutus, and others sought for protection from Pompey, whose fleet now covered the Mediterranean. Having satiated their vengeance and their avarice, the triumvirs announced to the senate that their cruelties were at an end: and leaving Lepidus with the charge of Rome, Octavianus and Antony marched into Asia to meet the conspirators.

Brutus having raised a powerful army in Macedonia, and Cassius another in Syria, they united their forces with the view of attacking Cleopatra, who was preparing to assist their opponents, when they received information of the advance of Octavianus and Antony at the head of forty legions. Brutus was desirous of passing over into Macedonia to meet the enemy; but Cassius insisted upon first reducing the Rhodians and Lydians, who had withheld their contributions. The unfortunate Rhodians were stripped of every thing but heir lives; and the Lydians, having shut themselves up n the city of Xanthus, and set fire to the town, threw hemselves into the flames rather than surrender to Brutus. The Roman general exhibited great generosity during the siege. He not only entreated his soldiers to extinguish the fire; but gave his personal assistance to save the infatuated Lydians, and even offered reward to every soldier who should save a Lydian rom the flames.

Having met at Sardis, Brutus and Cassius were, afer much altercation, reconciled to each other. Cassius ntertained Brutus in his tent; and it was after the eturn of the latter from this entertainment, that he aw the spectre of which we have already given an ccount in our life of **Brutus**, vol. V. p. 22. This vent was immediately followed by the battle of Philippi, in which the conspirators were defeated, and Cassius killed, as already described in the article now uoted.

Having assembled the dispersed troops of Cassius, recompensed them for their losses, and encouraged them with hopes of success, Brutus resolved, if possible, to starve his enemies, who were in great want of provisions. His troops, however, could not brook this species of warfare, and forced their general to try the fortunes of war. The force of the triumvirate was directed solely against the person of Brutus, and when the ranks of the confederates were giving way, orders were given not to permit the general to escape. Thus singly exposed as the prize of battle, the fate of Brutus seemed inevitable. In this emergency his friend Lucilius threw himself before a body of Thracian horse, who were closely pursuing Brutus, and on the point of seizing him, and called out that he was Brutus. The Thracians, overjoyed with their success, sent notice of it to Antony; but when that general received from Lucilius an acknowledgment of the deceit, he treated him with kindness, and sought the friendship of a man who had thus done honour to their common nature.

Death of Brutus.

Brutus escaped with a small number of his followers; and seating himself beneath a rock which concealed him from the enemy, he saw no prospect of escape, and throwing himself upon his sword, he instantly expired. The head of Brutus was sent to Rome, to be thrown at the foot of Cæsar's statue, and his ashes were sent to his wife Portia, who killed herself by swallowing burning coals. Thus fell the last of the enemies of Cæsar; and it has been affirmed, that not one of those died a natural death who were concerned in the murder of that great man.

Foolish conduct of Antony.

Elated with success, and dazzled with the pomp and consequence of his exalted station, Antony sought for the gratification of his vanity from a variety of sources. At Athens he courted the society of the philosophers, and assisted at their conversations and debates. In Asia he travelled from one state to another, receiving homage, exacting contributions, conferring favours, and distributing crowns, with insolent and capricious liberality. To Sysenes he gave the kingdom of Cappadocia, in consequence of the beauty of his mother Glaphyra. He settled Herod in the kingdom of Judea, and on Cleopatra he showered down the greatest favours.

His interview with Cleopatra.

As this celebrated queen had given succours to the conspirators, Antony commanded her to clear herself in person from this imputation of infidelity. She accordingly resolved to appear before him at Tarsus in Cilicia, which was situated at the mouth of the river Cydnus. Cleopatra made the most magnificent preparations for the visit. Her galley, equipped with sails of purple, shone with burnished gold, and the silver oars which impelled it kept time to the soft music of flutes and cymbals. Cleopatra herself lay reclined on a couch, adorned with stars of gold, and decked with all the emblems of the queen of love. Two boys, in the costume of Cupids, fanned her by turns, while the most beautiful women, in the character of Nereids and Graces, were placed in groupes around her. Perfumes were burnt on the banks of the river, while the galley descended the Cydnus, and arrived, in the midst of thousands of spectators, in the palace of Antony. Charmed, as might have been anticipated, with the loveliness of the Egyptian queen, Antony forgot to decide upon her cause, and neglecting all his affairs, abandoned himself to the licentiousness of love, and soon afterwards followed her into Egypt.

Octavianus having undertaken to conduct his veteran soldiers into Italy, and to settle them in the lands which he had promised as a recompense for their services, it was found upon their arrival that there was not a sufficient number of new grants, and that the old inhabitants must make room for the soldiers. Crowds of husbandmen and shepherds were thus driven from their habitations; and it was with difficulty that the immortal Virgil retained possession of his patrimonial farm.

Fulvia and Lucius raise a civil war.

The maritime sovereignty which Sextus Pompey exercised over the Mediterranean, had cut off the Romans from their usual supply of corn, and this general calamity was greatly increased by the insolence of the newly settled soldiers, and by the commencement of another civil war, which had been excited by the folly of Fulvia the wife of Antony. Jealous of Cleopatra, she considered a quarrel with Octavianus as the most likely means to withdraw her husband from Egypt. Her brother in law Lucius, who was the consul, aided her in this scheme, and insisted that Antony should have the same share as Octavianus in the distribution of the lands. Octavianus offered to refer this question to the decision of the army. But Lucius, declining this arbitration, placed himself at the head of six legions, consisting chiefly of the ejected peasantry. Octavianus however hemmed him in between two armies, and forcing him to return to Perusia in Etruria, he reduced him to such distress by famine, that he surrendered to the conqueror. Octavianus generously pardoned the aggressors, and returned to Rome in triumph.

Lucius defeated.

Antony marries Octavia.

Roused by the intelligence of his brother's defeat, Antony sailed in a considerable fleet from Alexandria to Tyre, and from thence to Cyprus and Rhodes. Leaving his wife Fulvia on her death-bed at Sicyon, he hastened to oppose Octavianus. The triumvirs met at Brundusium. A reconciliation took place, and was cemented by the marriage of Antony with Octavia, the sister of Octavianus. To the former was assigned the eastern division of the empire, and to the latter the west; while Lepidus was allowed the African provinces, and Sextus Pompey those Mediterranean islands which were already in his power.

Though the Roman people now expected a general tranquillity, yet the mutual jealousies of so many tyrants speedily involved the empire in fresh contentions. Antony and Pompey having quarrelled respecting the evacuation of the Peloponnesus, the latter renewed his piratical enterprises, and seized the corn which was consigned to Italy.

Octavianus opposes Pompey;

Octavianus now saw the necessity of putting down the naval power of Pompey. With a fleet which he had built at Ravenna, and another which Menodorus, who had separated from Pompey, had brought to his assistance, he invaded Sicily, but receiving a check from Pompey, and being afterwards disabled by a storm, he was obliged to postpone his designs. Reinforced, however, with one hundred and twenty ships from Antony, he again invaded Sicily, but being again shattered by a storm, he refitted his ships, and placed them under his friend Agrippa. After different battles Agrippa gave a final blow to the power of Pompey, who surrendered himself to Antony, by whom he was put to death.

who is defeated and killed.

Lepidus deserted by his army, and banished.

The ambition of Octavianus increased with the death of Pompey. He now resolved to reign alone; and the conduct of his colleagues afforded him reasons sufficiently plausible for this resolution. Lepidus had, without any reason, added Sicily to his province. He refused to listen to any expostulation on this subject, and Octavian having marched against him, the soldiers of Lepidus saluted him as their general. Lepidus threw himself in submission at the feet of his colleague, who spared his life, and banished him to Circæum.

Upon his return to Rome, Octavianus was idolized both by the senate and the people. The imprudence of Antony had displaced him from their affections; and it now became necessary, both for the welfare of Rome, and for the establishment of Octavianus's authority, to deprive Antony of his power and influence. The military reputation of Antony had suffered greatly from the failure of his expedition against the Parthians, in which he lost all his baggage, and nearly a fourth of his army; and his passion for Cleopatra seems to have led him into actions of such extravagance and vanity, that his fall could not be far distant. His triumphal entry into Alexandria, after his defeat in Parthia, his transference of several of the Roman Asiatic provinces to Cleopatra, his divorce of Octavia, and his marriage with the Egyptian queen, and above all, his idlé pageantries and his profligate life, rendered him unfit for any office under the commonwealth of Rome.

Octavianus skilfully availed himself of the failings and vices of his colleague, and after consulting with the senate, he made the most active preparation for war. Antony, being informed of this design, sent his lieutenant Canidius into Europe with his army, while he and Cleopatra set off for Samos to superintend the preparations for war. Both parties were now ready to commence hostilities. Antony had an army of 100,000, foot, and 12,000 horse, with a fleet of 500 ships of war. Octavianus was at the head of 80,000 foot and 12,000 horse; but his fleet was only half the size of Antony's.

The war began with a naval engagement near Actium, a city of Epirus. The rival fleets were drawn up in front of each other at the mouth of the Gulf of Ambracia; and the armies of the contending chiefs, marshalled on the opposite sides of the gulf, shouted for the commencement of the action. The prows of the vessels, armed with points of brass, drove furiously against each other, and on their sterns were erected towers, from which arrows were discharged by mechanical power. Octavianus's seamen fought with long poles, hooked with iron, and the combat was in this way maintained for a long time, with great equality of success. On a sudden, however, Cleopatra fled with sixty sail, and, what was still more unexpected, she was followed by Antony. The battle, however, still raged, and about five in the evening, Antony's fleet submitted to Octavianus. His army soon after accepted of terms from the conqueror, and Octavianus, without even a skirmish by land, had driven his antagonist from the empire.

After these misfortunes, Cleopatra conceived the extraordinary design of transporting her fleet over the Isthmus of Suez into the Arabian Sea; but the Arabians having burnt some of them which she had succeeded in carrying over, she abandoned her plan, and resolved to defend Egypt against Octavianus. Cleopatra would willingly have accepted of terms for herself; and Antony is said to have asked nothing more than the right of spending the rest of life in retirement. Octavianus, however, refused to listen to any proposals, and again trusted his cause to the decision of war. His lieutenant Gallus took Parætonium, and Octavianus himself invested Pelusium with another army. This stronghold, which might for some time have obstructed his march, was instantly surrendered, either from the cowardice or treachery of the governor, and Octavianus advanced without opposition to the gates of Alexandria. The troops of Antony made a desperate sally from the city, and gained a temporary advantage over the enemy's cavalry. This partial success revived his hopes, and encouraged him to make one desperate effort, both by sea and by land; but before taking this step, he challenged Octavianus to single combat, which was of course contemptuously declined.

Having placed his troops on an eminence in the neighbourhood of Alexandria, he ordered his fleet to engage that of the enemy. The galleys advanced in good order, but they immediately joined those of Octavianus, and retired peacefully into the harbour. The cavalry at the same time forsook him, and though his infantry remained steady, yet they were soon defeated and driven back into the city.

Cleopatra having circulated a rumour of her death, Antony stabbed himself with his sword, and Cleopatra, who was soon afterwards taken prisoner, perished by her own hands.*

After settling the affairs of Egypt, Octavianus left Alexandria in the beginning of September, and passing through Syria and other provinces of Asia Minor, he spent the winter in adjusting their various political concerns. In the beginning of the following spring, he went into Greece, and arrived in Rome in the month Sextilis, afterwards called August, when his victories were celebrated by three triumphs, which lasted for three successive days.

The undisputed sovereign of the whole Roman empire, Octavianus had now attained the summit of his wishes. Great as his ambition undoubtedly was, and numerous as the dangers were through which he reached the pinnacle of earthly greatness, he yet seems to have compared with the wisdom of a philosopher the honours and the dangers of imperial power. He recollected the aversion of the Romans to a kingly government; he saw before him his illustrious uncle, basely murdered on the seat of almost omnipotent power, and he dreaded that another assassin might attack him also upon the throne. On the other hand, he recollected the fate of Sylla. He admired his moderation in divesting himself of that supreme power which it had cost him so many lives to usurp; and he remembered that this monster of cruelty was allowed to die peacefully in his bed in the midst of men whose relatives he had murdered, and in the neighbourhood of a city which he had inundated with blood. In the dilemma in which Octavianus was thus placed, between his love of power and his dread of treason, he consulted his friends Agrippa and Mæcenas, in whose wisdom and honour he placed the firmest reliance.

Agrippa was deeply impressed with the same views which had forced themselves upon the fears of Octavianus; and he earnestly intreated him to restore liberty to his country, and to leave behind him the reputation of having taken up arms with no other view than that of revenging the death of Cæsar. Mæcenas, on the other hand, represented to him the danger of renouncing his authority. He impressed it upon his notice, that the tranquillity of the state depended on the indivisibility of the sovereign power. He urged it upon him as the golden rule in government, to govern others as he would wish to be governed had it been his destiny to obey; and he suggested to him that under the title of *Cæsar* or *Imperator*, he might enjoy all the influence of a king without offending the prejudices of his countrymen.

Conduct of Octavian.

Octavianus thus supported in his natural attachment to power, followed the advice of Mæcenas. He paid the greatest attention to the people, and amid the cheapness and abundance of provisions, the shows and games with which they were amused, they were not sensible of the authority which was exercised over them. He made a census of the people in his sixth consulship, and found the number of men fit to bear arms to be 463,000. He abrogated the iniquitous laws which had been created during the triumvirate. He erected many public edifices; he repaired those which had gone into decay; he ornamented the city in various ways, and by attending to the details of business, by reforming abuses, and by appearing in person at the public amusements, he fixed himself deeply in the affections of the people.

Receives the title of Augustus.

Extent of the Roman empire.

Having entered upon his seventh consulship, he went to the senate house, and by the advice of Agrippa and Mæcenas, he offered to resign his authority into the hands of the people as under the old commonwealth. The senators besought him to take upon himself the sovereign authority; but though he reluctantly accepted of this request, he refused to hold it for more than ten years. A new name was thought necessary to characterise this new power, and though the name of Romulus was considered by many as the most appropriate, yet that of *Augustus* proposed by Manutius Plancus was preferred and adopted. Thus terminated the commonwealth of Rome, and thus commenced the greatest monarchy that the world had ever seen. The Roman empire now extended over a length of 4000 miles, and a breadth of nearly 2000, and included the greater part of Europe, Asia, and Africa. Its annual revenue amounted to about forty millions of our money. The people were rich and in comfortable circumstances, and the great body of the population were sunk in luxury and effeminacy.

Augustus subdues the Asturians.

Having gained completely the affections of the people, Augustus used every means to render permanent the attachment which already existed between him and his soldiers. He maintained a standing army of twenty-three legions, of which seventeen were stationed in Europe, viz. eight on the Rhine, four on the Danube, three in Spain, and two in Dalmatia. The other eight were placed in Asia and Africa, four on the Euphrates, two in Egypt, and two in ancient Carthage. This army amounted in all to 170,650 men. The emperor's guard consisted of twelve cohorts, or about 10,000 men, who were stationed in the vicinity of Rome. The navy of Augustus consisted of two powerful fleets, one of which was stationed at Ravenna on the Adriatic, and the other at Misenum in the Mediterranean. The senators of Rome, like the people, soon felt that they were under absolute dominion. They were on all occasions consulted by Augustus, and were so highly satisfied with his conduct, that they added to his other titles that of Father of his Country.

Having thus wisely arranged the public institutions of the empire, Augustus felt himself obliged to attack the Cantabrians and Asturians, two Spanish nations, who had never yet yielded to the Roman power. In that war, the Romans met with a formidable resistance, and it was with great difficulty that they succeeded in subjugating these warlike nations.

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* The particulars of the deaths of Antony and Cleopatra have been already minutely detailed in our lives of these two distinguished persons.

Honours paid to Augustus.

The reputation of Augustus, not only as a warrior, but as a legislator and statesman, had extended to the remotest kingdoms. Phrahates, king of Parthia, offered to enter into a treaty with him on his own terms; and Porus, king of India, sent to him three ambassadors, intrusted with a letter in the Greek language, informing him that he held dominion over 600 kings, and that he valued so highly the friendship of Augustus, that he would meet him at any place he should appoint, and would assist him in any right cause. Of these three ambassadors, two died on the journey; the third, who was a Gymnosophist, and named Zarmar, met Augustus at Samos, and accompanying him to Athens, he there burnt himself in his presence.

Unstable condition of the empire.

The Roman empire had now extended itself far beyond those limits which nature had assigned it. Rome, venerable from its antiquity, distinguished by its literature, by its arts, and by its arms, was indeed a powerful centre, capable of holding together, and of drawing into its vortex the most distant and scattered elements; but the equilibrium which it enjoyed was one of tottering stability, which one impulse might disturb, and which one irruption might for ever destroy. That stable poise which tends to right itself when it is disturbed, and which can arise only in a state consolidated by common interests, and held together by the frame-work of equal laws, was unknown to Rome in her best days, and has perhaps been witnessed only as a phenomenon of modern legislation. The wide-spread dominions of the Romans embraced many heterogeneous elements. Bounded by states little raised above savage life, frequent incursions were made into its remote provinces; and encouraged by success, the Germans in the north of Europe made a formidable irruption into Gaul. Though at first repulsed with loss, yet they had set the example of disobedience; and the Rhæti, who lived near the Lake of Constance, entered Italy, laying waste every territory through which they passed, and putting man, woman and child to the sword. Drusus, the second son of the Empress Livia, was sent out against the invaders, and gained a complete victory over them; and the remnant of that army having been joined by the Vindelici and Norici were reduced by Tiberius, Drusus's elder brother, and yielded to the Roman power. In order to maintain these tribes in subjection Augustus established two colonies in Vindelici, and constructed a road from thence into Noricum and Rhætia. For the defence of these colonies he built two cities, *Drysomagus* and *Augusta Vindelicorum*, now Nimeguen and Augsburg.

B. C. 17.

Drusus conquers the Rhæti.

Augustus made Pontifex Maximus.

B. C. 13.

Augustus was now raised to the spiritual honour of Pontifex Maximus; an office which was filled by all his successors; and in this new capacity he improved the calendar, and burned 2000 pontifical books, reserving only those of the Sybilline oracles.

Death of Agrippa.

B. C. 11.

Agrippa, who, since the elevation of Augustus, had held the important situation of governor of Rome, died of a violent fever in Campania, (see our article Agrippa, Vol. I. p. 358,) and was succeeded in the government of Rome by Tiberius. Augustus, however, commanded him to divorce his wife Agrippina, and to marry Julia, the wife of Agrippa, and the daughter of the emperor, whose abandoned conduct had been kept a secret only from her father.

Although Agrippa had subdued the Pannonians, yet the news of his death had inclined them to shake off the Roman yoke, and Tiberius and Drusus were sent to subdue them. After having achieved several brilliant victories in Germany, Drusus was carried off by a violent fever; and Tiberius, after reducing the Pannonians, succeeded to the chief command in Germany, where he obtained several victories which restored the general tranquillity. On his return to Rome Tiberius received the honour of a triumph, and was appointed to the tribuneship for five years; but disgusted probably by the debaucheries of his wife Julia, or offended at the honours and titles which Augustus had conferred on his grandchildren, he asked leave to quit Rome, and retired to Rhodes. Notwithstanding the remonstrance of his mother Livia, and the positive refusal of Augustus to comply with his request, Tiberius persisted in his resolution, and, confining himself to his apartment, he refused for whole days to take any food. Augustus finding it without avail to resist so implacable a temper, permitted him to retire to Rhodes. Tiberius, however, soon repented of the rashness of this scheme, and requested leave to return to Rome; but Augustus compelled him to remain at Rhodes for seven years; and though Livia obtained for him the appointment of the emperor's lieutenant in these countries, yet Tiberius during the whole of his stay at Rhodes appeared only in the character of a private individual.

A peace, profound in its character, and universal in its extent, now reigned throughout the known world. The temple of Janus itself was shut, the signal of peace and tranquillity, with the sight of which Rome had never once been blessed since the days of Numa Pompilius. At this moment of general benignity, when Rome gloried in her wisdom as well as in her power, and when her attention was distracted by no pursuits of interest or of glory, the Saviour of the world was born in Judea, 753 years after the foundation of Rome. About three years after this event Tiberius was permitted to return to Rome, but was not allowed to hold any public situation. The death, however, of Lucius and Caius Cæsar, the two grandsons of Augustus, on whom he had conferred the title of princes of the Roman youth, opened to Tiberius the prospect of being one day the sovereign of Rome. Although it was suspected that Livia had carried them off by poison, yet Tiberius had shown such unaffected sorrow at their death, that Augustus adopted him as his son.

A second irruption of the barbarous hordes of the north again disturbed the empire. Three legions and six cohorts, under Quintilius Varus were almost entirely cut to pieces in Germany by Arminius, a brave but crafty general; and, when Varus saw that every thing was lost, he and several of his officers put themselves to death. His head was afterwards sent by the insurgent general to Augustus, who was almost driven frantic by the defeat. He allowed his hair and his beard to grow for many months; he tore his garments, and, in fits of distraction, he beat his head against the wall, exclaiming, Oh! Varus, restore me my legions.

To retrieve this disaster Tiberius was sent into Germany, where he performed many brilliant exploits, upon which he was honoured with a triumph by the Romans, and by Augustus with his friendship. Tiberius was now assumed by Augustus as his colleague, and, having sent Germanicus against the northern hordes, Augustus accompanied Tiberius during a part of his journey; but having been taken ill at Nola in Campania, he died in the 76th year of his age, and 56th of his power, having held the sovereign authority for 44 years. As Augustus had shown some marks of returning affection for his grandson Agrippa Postumius, it has been suspected that Livia hastened his death, by giving him poisoned figs. Augustus recommended Tiberius as his successor. He left his fortune partly to Tiberius and partly to Drusus; and he bequeathed legacies both to the people and the army. The virtues of this great man have been embalmed in the writings of Virgil, Horace, and Ovid; and the *Augustan age* of Roman literature has been celebrated by the admiration of all succeeding ages.

Tiberius began his reign by acts of cruelty and deceit. After causing Agrippa Posthumius to be murdered by a military tribune, Tiberius affected to hesitate about the acceptance of the supreme power. The two consuls, however, having first reluctantly taken the oath of fidelity to him as emperor, administered it to the senate, the people, and the soldiers; yet notwithstanding all this eagerness in his service, Tiberius declared that he would only hold the empire till the conscript fathers should, in their great wisdom, think proper to give repose to his old age.

The festivities and consequent relaxation of discipline in which the Roman armies were permitted to indulge on the accession of Tiberius, gave rise to two revolts of a most alarming nature. Percennius, a common soldier, and known in Rome as the ringleader of hissing parties in the theatre, had excited his fellow soldiers by inflammatory speeches. Tiberius himself wrote to the insurgents; but finding his remonstrances unavailing, he sent his son Drusus to try the influence of persuasion and of force. The insurgents, however, massacred several of their officers; and it was only by the effect of an eclipse of the moon on their superstitious feelings that they were brought to reflection. Drusus availed himself of this favourable incident, and having condemned and executed some of the ringleaders, the mutiny was completely subdued with the timely aid of some violent storms which had alarmed their fears.

The revolt which took place in Germany almost at the same time, and from the same causes, assumed a more inveterate character. When the insurgents had gone so far as to drown several of the centurions in the Rhine, Germanicus hastened from Gaul to restore subordination. Unable, however, to effect any change, he feigned letters from Tiberius, in which it was agreed that all soldiers who had served sixteen years should be deemed veterans; that those who had served twenty should be discharged; and that some legacies which had been bequeathed to them by Augustus should be paid to double their amount. When this money was paid, the troops retired peaceably into their quarters. The arrival of deputies, however, from Tiberius, gave rise to a report that their object was to revoke the terms granted by Germanicus; and notwithstanding that every assurance was given them that the report had no foundation, yet they attacked the deputies, and conducted themselves with such outrageous violence, that Germanicus thought it prudent to send home his wife Agrippina, who was then pregnant, along with her infant son Claudius; and many of the principal officers followed his example.

No sooner was Agrippina seen, with her infant in her arms, preparing to seek for refuge from the treachery of Roman soldiers, than an impression was made on the feelings of the insurgents which no arguments could have produced. Some of them now ran to prevent her from quitting the army, while others went to Germanicus, and entreated him to recal his wife. Having seized and massacred their own ringleaders, all the legions except two returned to their allegiance. Cæcina, who commanded these two legions, having misunderstood a message from Germanicus, called out those who had not joined the insurgents, and led them to the massacre of the disaffected. Germanicus was distressed beyond measure at this piece of cruelty, and endeavoured to expiate it by performing every mark of respect to the bodies of those who had fallen.

Who defeats the Marsi, A. D. 15.

Having thus brought his army to a proper sense of their duty, Germanicus erected a bridge over the Rhine, and marched across with 12,000 legionaries, 26 cohorts of allies, and about 2400 cavalry. There he fell in with the Marsi, and surprising them in the midst of a festivity and debauch, he slaughtered the whole army, and laid waste the country for fifty miles round with fire and sword. He next entered the country of the Cotti, and having, after some resistance, burnt their villages and towns, he destroyed their capital and returned to the Rhine.

The Cotti,

Germanicus was now called to oppose the army of Arminius, who had cut to pieces the Romans under Varus. Having marched against them while besieging Segestes, an ally of the Romans, he routed his forces; and took many prisoners, among whom was Thusneldis, the wife of Arminius, whom he had carried off against the will of her father Segestes. Enraged at the loss of one to whom he was deeply attached, Arminius arrayed all the neighbouring kingdoms against the Romans. In marching against Arminius, Germanicus fell in with the dead bodies of the Roman soldiers who had fallen under Varus, and who had been left unburied on the field. These he committed to the earth with all the ceremonies which he had leisure to perform. In this expedition various battles were fought, in which both parties were successful by turns. The Romans had gained few advantages, and retired into winter quarters, after experiencing great losses of every kind.

In his next expedition, for which he had made vast preparations, Germanicus was more successful. He marched against Arminius, who was encamped on the opposite bank of the Weser; and who had resolved to dispute the passage of the river. Cariovalda, the leader of the Batavian auxiliaries, crossed the river, and was slain in an ambuscade, which had been laid for him by the enemy. Stertinius and Æmilius, having hastened to the assistance of the Batavians, Germanicus in the mean time passed the river, and defeated the Germans with such slaughter, that the country for ten miles round was covered with arms and with dead bodies. After another victory, Germanicus put an end to the campaign. He sent some of his legions into winter quarters by land, while he embarked with the rest in order to return by sea; but a violent storm arising, his fleet, of a thousand vessels, was dispersed in all directions. Some of them were swallowed up in the ocean, others were dashed against the rocks, while many were driven to distant and barren shores, where the men either died of hunger, or protracted a miserable existence, by feeding on the flesh of the dead horses which had been thrown overboard, to lighten the sinking vessels. Many of the troops, however, were saved, and a considerable number of the ships recovered; those who had been driven on the coast of Britain having been generously sent back. After several other successful expeditions against the Germans, Germanicus was recalled by Tiberius. He was afterwards appointed along with Piso to the government of Syria, but he died of poison, which was supposed to have been

And Arminius.

A. D. 17.

administered to him by his colleague. As the army of Germanicus had offered to raise him to the empire, an honour which he had the virtue to decline, Tiberius had always viewed him with a jealous eye; and though he punished Piso with death, he yet felt that the act for which it was inflicted had relieved him from a rival whom he feared.

A. D. 20.

Tiberius therefore threw off the mask which the dread of Germanicus seems to have compelled him to wear. He diminished the authority of the senate, as well as the liberties of the people. He assumed to himself even the right of interpreting and of enforcing the laws. In this state of affairs, Sejanus, by birth a Volscian, but possessed of the rank of a Roman knight, had insinuated himself into the confidence of Tiberius. He made him captain of the Prætorian guards; and no sooner did Sejanus find himself in this situation of power and influence than he began to aspire to the sovereignty. After debauching Livia, Drusus's wife, he prevailed upon her to remove her husband by slow poison. Finding it difficult to make any attempt on the children of Germanicus, both from the chastity of their mother and the fidelity of their governors, he conceived the deep plan of removing Tiberius from the city, by which he might have more frequent opportunities of carrying on his designs. Tiberius's love of indolence and licentiousness of every kind led him to prefer a country life, remote from business and from observation. Sejanus artfully represented to him the dangers and troubles which might arise from the seditious temper of the Roman populace; and having already experienced the fatigues of attending the senate, the emperor retired into Campania, under the pretence of dedicating temples to Jupiter and Augustus. He varied his residence from one place to another; but he dwelt principally in the island of Capræa, on the coast of Campania, where he buried himself in the most unlawful and infamous pleasures. In the sixty-seventh year of his age, this bloated voluptuary, covered with ulcers, bent down and reduced to a shadow by dissipation, collected around him the dregs and outcasts of society, who could minister to his brutal appetites. To his other vices he added those of gluttony and drunkenness; and the power of drinking off five bottles of wine at a draught was deemed a qualification for the prætorship. As he became more abandoned, he became more cruel and suspicious. Spies and informers were placed in every society; and this machinery was skilfully directed to his own purposes by Sejanus, who wrought upon the emperor's fears. The sons of Germanicus alone stood in the way of Sejanus's ambition. He contrived to render them obnoxious to the emperor by stories of their ambition; while he frightened them in return by reports of cruelties which were intended against them. He succeeded at last in getting the two princes, Nero and Drusus, declared enemies to the state, and afterwards starved to death in a prison. From that hour the rise of this favourite was unexampled. He enjoyed the entire confidence of Tiberius, and possessed omnipotent power over the senate. Statues without number were erected to him, crowds of idolaters offered incense at his shrine; and never was there a despot with more absolute authority, or more the object of dread, than Sejanus. The rapidity of his rise, and the elevation to which he had attained, seem to have been designed as a contrast to the precipitancy of his degradation, and the depth of his fall. He was at once accused of treason by Satrius Secundus, and the accusation was seconded by Antonia, the mother of Germanicus. Tiberius was satisfied of its truth; but, destitute of courage, he still pretended to entertain for him his usual respect. He even granted him new honours, and made him his colleague in the consulship; and while he commanded the senate to put him in prison, he ordered soldiers to guard him, and prepared ships to favour his escape. The senate, however, went beyond their orders, and consigned him to execution. He was now deserted by all. The people loaded him with insults and execrations, and after his execution, his body was dragged through the streets, and his whole family put to death.

Sejanus aims at the sovereignty.

A. D. 27.

This event seems to have roused in Tiberius a passion for executions. He filled the prisons with the supposed accomplices of Sejanus, and he ordered all the accused to be put to death without examination. Out of twenty senators whom he elected as his council, he put to death sixteen; and he at last seems to have inflicted tortures and even death for his own amusement. While the tyrant was thus glutting himself with Roman blood, and feasting his eyes on the torments and agonies of his victims, the provinces of his empire were left under the protection of avaricious lieutenants, who were more intent upon the accumulation of wealth than anxious for the safety of the state. The barbarians harassed the provinces on all sides. The Dacians and Sarmatians seized upon Mœsia; the Germans desolated Gaul; and Armenia fell under the dominion of the King of Parthia. Though sunk in vice and pleasures, the monster yet seems to have been distressed at these encroachments upon his power; and it is said, that in one of these fits of distraction he was heard to wish, that heaven and earth might perish when he died. Forsaken by his appetites, insensible to the stimulants even of the worst vices, and debilitated by their too frequent applications, Tiberius felt that his dissolution was approaching; and he is said to have named Caligula his successor, in the hope that the enormity of his crimes might blot out the recollection of his own. This detestable motive, which human nature shudders in recording, has perhaps been invented by his enemies; but, on the other hand, history has informed us, that Tiberius was heard to avow, that Caligula possessed all the vices of Sylla without his virtues; that he was a serpent that would sting the empire, and a Phaeton that would set the world in flames.

Though Tiberius thus made some preparation for his departure from the world, he yet strove to conceal the symptoms of its rapid approach. He sought in a change of place to keep down the feelings which harassed him. Having at last settled at the promontory of Misenum, his infirmities increased, and he one day fell into a succession of fainting fits which all around him believed would prove fatal. His favourite Macro, looking for new honours, advised Caligula to secure the succession. The court congratulated Caligula, the Prætorian soldiers acknowledged him, and the multitude had added their applause, when the unexpected recovery of Tiberius struck terror and alarm into all parties. Sorrow for the dying emperor again sat on every countenance. Caligula, as if moonstruck, expected to exchange an empire for a grave; when Macro again converted his mourning into joy by smothering the dying emperor with pillows, or, as others say, by cutting him off with poison. Thus was terminated the base career of Tiberius, in the 78th year of his age, and the 22d of his reign.

During the latter days of Tiberius, the vices which degraded the sovereign, extended their pollutions over all classes of the population. Pleasures which were most unnatural, were most prized. Men called Spintriæ carried on the trade of inventing new kinds of pleasure and licentiousness. Gluttony had been reduced to a system by Apicius Cælius, who hanged himself after he had devoured his estate; and every form of vice, and every variety of folly and licentiousness, now seemed to have been swept from the superficies of the empire and concentrated in Rome.

In the 18th year of the reign of Tiberius, our Saviour suffered crucifixion under Pontius Pilate the Roman governor of Jerusalem, who is said to have sent to Tiberius an account of his passion, resurrection, and miracles. The emperor, struck with the singularity of the statements, reported them to the senate, and desired that Christ should be ranked among the gods of Rome. The senate, however, declined his request, and even ventured to command all Christians to leave the capital. Tiberius, however, is said to have issued another edict which threatened all who accused them with death, and thus permitted them, during the rest of his reign, to reside unmolested in the city.

Caligula succeeded to the empire under auspices of a most favourable kind. His father Germanicus had been adored by the army and the people, and he himself had been bred among soldiers, and had shared in their toils. The congratulations of the senate and of the people met him as he advanced to Rome, mourning over the dead body of Tiberius. Remote sovereigns courted his alliance, and the whole world seems to have given him the credit of every virtue.

The early conduct of Caligula did not belie these extravagant expectations. Having presided at the funeral rites of Tiberius, he brought to Rome the ashes of his mother and his brothers, and instituted annual solemnities to their honour. He revived the institutions of Augustus that Tiberius had ruined. He reformed abuses; he punished the corruption of governors; he banished the Spintriæ; and sent Pontius Pilate an exile into Greece; he restored the election of magistrates by popular suffrage, and he performed many acts of liberality and virtue which gave him a just claim to the gratitude and admiration of the people.

That such a character should at once change into that of a furious madman, and a cruel and capricious tyrant, without any apparent motive or any reasonable cause, is not within the limits of belief. We are disposed, therefore, to place some confidence in the assertion, that a disorder which took place after his accession to power, had destroyed his intellects and altered his nature. Acts of individual cruelty were the first symptoms of his insanity. One Politus had loyally devoted himself to death if the emperor should recover, and another Secundus had vowed to fight in the amphitheatre on the same account. No sooner had the emperor recovered, than he compelled them both to fulfil their vows. Gemellus who had been left by his grandfather Tiberius co-heir with Caligula, was ordered and compelled to put himself to death. Silenus, the emperor's father-in-law, was the next victim, and Gercinus, a senator of great probity, shared the same fate, for refusing to give false witness against Silenus. Among the numerous victims of his suspicion and avarice, was Macro, to whom Caligula was indebted for his sceptre.

The absurd vanities of Caligula form a sort of relief to the details of his cruelties. He took to himself the title of ruler. He ordered divine honours to be paid to him, and he assumed the names of such of the gods as were at the time most agreeable to him. He decapitated the statues of Jupiter and some of the other deities, and ordered his own head to be put upon their trunks. He seated himself between Castor and Pollux, and commanded their worshippers to pay their adoration to him; and he finally added their temple to his palace in the form of a portico, in order that the gods might become his porters.

Murder of Caligula, A. D. 41.

These depravities, together with his licentiousness and prodigality, of which we have given a detailed account in his life, (See Caligula, vol. V. p. 258,) at last roused the patriotism of the Romans. Cassius Cherea, a tribune of the Prætorian bands, conceived and executed the plan of terminating the frightful reign of Caligula. This monster of iniquity was dispatched with thirty wounds, and died in the 29th year of his age, and the 4th of his reign. His wife and infant daughter perished along with him; a centurion stabbed the one, and the brains of the other were dashed out against a wall.

Claudius chosen emperor, A. D. 41.

Claudius kills Cherea.

Although the conspirators had destroyed the tyrant, they neglected to provide a successor to the throne. An attempt was made by Saturninus, who was then consul, to impress upon his countrymen the value of a free government. The senate listened with eagerness to the proposal, and having brought over some cohorts of the city to their views, they boldly seized upon the capitol. Such an attempt, however, was vain. The army and the mob, dazzled with the public spectacles with which the emperors had indulged them, and recollecting the donations which they had received, saw no advantages but in a monarchical government. Between these contending opinions, chance at last decided. Claudius, the uncle of Caligula and the nephew of Tiberius, was found accidentally by the soldiers, and he was immediately carried to the camp upon their shoulders, and proclaimed emperor. The senate passed a decree confirming this choice, and with some reluctance they went to pay him homage. Cherea was the first victim whose life Claudius demanded. With the fortitude of an ancient Roman, he begged that he might perish by the same sword with which he slew Caligula. His friend Lupus suffered death along with him, and Sabinus, who had been a partner in the conspiracy, fell by his own hand.

Claudius dies by poison. A. D. 54.

Claudius, whose history has been detailed at sufficient length in our account of his life, was poisoned by his wife Agrippina in the 64th year of his age, and the 14th of his reign.

Nero proclaimed emperor, A. D. 54.

In order to secure the succession of her son Nero to the throne, Agrippina concealed the death of Claudius. Alarmed lest Britannicus, the son of Claudius by his first wife Messalina, should be chosen by the army, she kept him and his sisters Octavia and Antonia out of the way, and when her schemes were all arranged, she threw open the gates of the palace, and Nero, attended by the prefect of the Prætorian guards, presented himself to secure the gratulations of the army and the people. After being proclaimed emperor with shouts of joy, he was carried in a chariot to the rest of the army, and having made a speech and promised donations, he was declared emperor by the united voices of the army, the senate, and the people.

At the age of seventeen, Nero began his reign in a manner which held out the prospect of better times. At the funeral obsequies of Claudius he pronounced an oration which was drawn up by his tutor Seneca. His mother, Agrippina, to whom he submitted with implicit obedience, already began to gratify her private animosities. Without Nero's knowledge she procured the assassination of Silanus, the proconsul of Asia, and contrary to Nero's wishes, she compelled Narcissus to put an end to his own life. These cruelties, however, did not last long. Burrhus, the prefect of the Prætorian guard, and Seneca openly opposed the continuance of these cruelties. With the consent of Nero they laid down a plan of government both merciful and wise; and while Nero followed their counsels his conduct was considered as a model to succeeding princes. He was not only just and liberal and humane, but condescending and affable; and the Romans fondly hoped that the tyranny of former sovereigns would be balanced by the clemency and wisdom of Nero.

These expectations, however just and reasonable, were soon disappointed. Nero had concealed the depravity which nature had implanted in his heart, and, as circumstances arose to call it forth, it began to develop itself in all its hideousness. Having fallen in love with a freedwoman of the name of Acte, he excited the rage of his mother, who dreaded that her own influence would be transferred to a concubine.

Nero quarrels with Agrippina.

He exerted every nerve, therefore, to thwart her wishes, and showed his displeasure by displacing Pallas, her principal favourite. Enraged at the slight which was thus put upon her, Agrippina pronounced Nero an usurper, and declared that Britannicus, the heir of his father's throne, was still alive. The depravity of the emperor's heart was now called forth.

A. D. 55.

He contrived to have Britannicus poisoned at a public banquet, and he abridged the privileges of Agrippina, and prohibited her from being visited by persons of whom he was suspicious.

Having shaken off the yoke of Seneca and of Burrhus, Nero gave way to rioting and licentiousness. Disguised as a slave, he prowled about the city, frequenting taverns and brothels, and attempting to kill every person who interfered with him. These extravagancies, vicious as they were, found still some apology in the youth and circumstances of Nero; but as he advanced in years his crimes became more detestable. Abandoning his wife Octavia, he cohabited with Poppea, the wife of his favourite Otho. Enraged at this connexion, Agrippina became the enemy of Poppea, who retaliated by persuading Nero to get rid of his mother. Nero yielded to this request. He tried to break her spirit by various petty but ineffectual vexations. He next tried the effects of poison, but though twice administered, she resisted its effects. He attempted to drown her by giving her a pleasure sail on the coast of Calabria, in a ship so built, as to fall to pieces in the water; but this experiment was ill managed, and Agrippina contrived to support herself above water till she was picked up by a trading vessel. Unable to extinguish the vitality of Agrippina, Nero consulted Seneca and Burrhus, but both of them declined to have any concern with such a deed. In this perplexity, Anicetus, the contriver of the ship, offered his services, and Nero is said to have exclaimed on the occasion, "That he never before felt himself an emperor." Anicetus, however, having already failed in his machinery, had recourse to a more direct method.

Whom he murders.

Attended by a body of soldiers, he surrounded Agrippina's house, forced open the doors, and dispatched Agrippina with many wounds. Nero was sent for to see that the deed was rightly done; and after surveying the body, he remarked that he never thought his mother had been so handsome.

Having been applauded by the senate for this horrible parricide, Nero had no occasion to follow any other will than his own. Satiated for a while with his mother's death, he now addicted himself to music and to chariot driving. He at last became a principal performer in the chariot races; and having been well received in this new capacity, he soon afterwards exhibited as a singer on the stage; making his first public appearance at the juvenile games instituted by himself. His next passion was to be a poet and a philosopher. The wits about court contributed their instalments of written and extemporaneous verses, which, when tacked together by his orders, became a poem by Nero. In like manner, he attended the debates and sought the society of philosophers.

Having thus become a player of all work, Nero resolved to make the tour of his empire, to display his varied accomplishments. At Naples, the imperial performer so rivetted the attention of his audience, that an earthquake, which happened during one of his songs, was not felt in the theatre. Like other artists of moderate ability, he ran down his brother performers; he intrigued with his judges, and organized clubs and factions to applaud and to support him. Soldiers were stationed everywhere to make the hearers applaud at the right time, and to prevent any person whatever from leaving the house. Some fell into swoons in order to be carried out: several women were delivered in the theatre; and Vespasian, an old senator, and afterwards emperor, having been overpowered by sleep, while Nero was chanting one of his choruses, narrowly escaped with his life.

The cities of Greece having sent deputies to Nero to inform him that they had made a law to transmit to him the crowns for all the games, the emperor entertained them in the most elegant manner. Knowing the weakness of the monarch, they requested him for a song, which they honoured with bursts of applause. Finding that his musical powers were so highly appreciated by this refined people, he spent a whole year in Greece, where his suite consisted of dancers, singers, tailors, and other appendages of a theatre. He displayed his prowess at all the games. At the Olympic games, he drove a chariot with ten horses, and though he was jerked from his seat, yet he was crowned as the conqueror. At all the other games he was equally successful, and he obtained no fewer than 1800 crowns. On one occasion he was opposed by a good singer, whose voice had surpassed his prudence, for Nero ordered him to be killed on the spot. His entry into Rome was the grandest pageant which the Romans had been called to witness. Seated in the chariot of Augustus, shining in Tyrian purple, and crowned with the Olympic garland, he carried on his head the Pythian crown, and had 1100 crowns borne before him. Beside him was a musician, and behind him a band of virgins, who celebrated his victories by their vocal powers. The city was in a blaze of joy, and every kind of incense was offered to the royal performer. The next ambition of Nero was to excel in strength, and appear as a Hercules redivivus; and after he had taken lessons in boxing and wrestling, he had a pasteboard lion erected in the theatre, which he assailed and struck down with a single blow.

One of the most extraordinary events in the history of Rome, namely, the burning of the city, has been with some degree of plausibility ascribed to the wickedness of Nero. This great fire began in shops filled with combustible materials, and spread with unexampled rapidity. Commencing in the lower parts of the city, it extended with astonishing rapidity to the higher parts. All attempts to stop the progress of the flames were prevented by persons that seemed stationed on purpose, and these same persons were seen to throw lighted firebrands into the houses, and did not scruple to declare that they had authority for doing so. After raging six days, the progress of the conflagration was at last stopped at the foot of the Esquiline Mount, by pulling down a number of buildings. Nero, who was at Antium during the fire, is said to have mounted his private stage, and to have sung the destruction of Troy on account of its supposed resemblance to the present calamity. When he heard, however, that the flames were approaching his palace, he came to Rome, but just in time to witness the destruction of the palace. Nero appeared to feel some compassion for the poor Romans whom this desolation had left houseless and distressed. He laid open the field of Mars, and even his own gardens to receive them. He ordered tents to be erected; he lowered the price of corn, and had all sorts of furniture and necessaries brought from Ostea.

While provision was thus making for the forlorn populace, another conflagration broke out; but it was chiefly confined to the spacious part of the town occupied by public buildings and ornaments, and therefore did not occasion such distress to the inhabitants. Only four out of the fourteen quarters of Rome remained entire. Among the public buildings which perished was the temple dedicated to the Moon by Servius Tullius, the temple and altar which Evander erected in honour of Hercules; the chapel to Jupiter Stator, built by Romulus; the Court of Numa, and the Temple of Vesta. Along with these superb monuments of antiquity, there were destroyed many of the treasures acquired in war, the finest paintings and sculptures of Greece, and the writings of many illustrious authors.

After the destruction of the city, Nero's first care was to provide for his own accommodation. Severus and Celer designed a palace of huge dimensions, which, according to Pliny, extended quite round the city. It embraced within its circle hills, wildernesses, lakes, forests stocked with wild beasts, green and spacious fields. The galleries consisting of three rows of lofty columns, were each a mile long, and at the entrance of the palace was a colossal statue of Nero 120 feet high. The walls of the palace were covered with gold, and it was roofed with the same metal, from which it got the name of the Golden House; and the interior was adorned with a profusion of golden ornaments, precious stones, and mother of pearl. The wood work was inlaid with gold and ivory, and the dome of one of the banqueting rooms had a diurnal motion like the heavens. Having found Nero enter so warmly into the projected palace, Severus and Celer proposed to him to cut a canal from the Lake Avernus to the mouth of the Tiber 160 miles long and ten broad, that two galleys of five banks of oars might pass abreast. Nero entered keenly into the project, which had the merit of being useful, as it opened a free communication between Rome and Campania. Convicts from all parts of Italy were collected, and incredible sums expended on the work; but the labour of cutting through the hard rocks and steep mountains which intervened rendered it necessary to abandon the undertaking.

Rebuilding of Rome.

In rebuilding the city, a regular plan seems to have been adopted. The streets were straight and spacious, and regularly disposed; the height of the houses was fixed at about seventy feet, the courts were enlarged, and Nero, at his own cost, added large porticos to the great houses which stood by themselves. In order to prevent fire, the houses were raised to a certain height without wood; they were arched with props of stone; the common springs were not allowed to be diverted for private use; no mutual walls were allowed, and every citizen was compelled to have a machine for extinguishing fires.

Persecution of the Christians.

After the city was burnt, Nero attempted to cast the blame on the Christians, who had begun to increase rapidly in Rome; and he thus excited against them a dreadful persecution, of which we have given an account in another part of our work.* The cruelties which Nero exercised against the Christians were soon extended to all ranks of the community. These atrocities took their rise in a conspiracy which was organised by Piso, a man of great integrity and influence, and which seems to have embraced some of the leading men in the state. Through the rash zeal of a woman, named Epicharis, the plot to which he was a party was allowed to transpire. Confessions were extorted from some of the inferior agents; but Epicharis could not be brought, either by scourging or burning, to disclose a single name. In consequence, however, of the information which was obtained, Piso, Vestinus the consul, Lateranus, Fennius Rufus, Subrius Flavius, and Sulpicius Asper, with many other persons of distinction, suffered death. Seneca, who had retired into private life, and his nephew Lucan the poet, were also accomplices, and fell victims to their hatred of Nero. The suspicions of Nero fell upon persons of all ranks, and in all parts of the neighbourhood of Rome; and every day groupes of victims were dragged to the palace, to receive their sentence from the tyrant himself; who, accompanied by his favourite and profligate minister Tigellinus, presided personally at the torture. The provinces did not escape from these scenes of cruelty; and the governors seem to have done homage to the imperial tyrant, by an imitation of his atrocities. The cruelties exercised in Judea by Florus, a bloody and avaricious ruler, excited a revolt among the Jews, which set an example that was speedily followed.

Piso conspires against Nero, A. D. 65.

His general Corbulo, who had carried on a successful war against the Parthians, during the greater part of Nero's reign, and who finally subjugated that people, fell a sacrifice to the cruelty of Nero; and his empress Poppæa, whom he kicked in her pregnancy, miscarried and died by the blow.

Revolt of Vindex and Galba.

The detestation which these actions excited, prepared the public mind for the overthrow of Nero's power. Julius Vindex, who commanded the Roman legions in Gaul, impelled only by his hatred of tyranny, openly raised the standard of revolt; and when he heard that Nero had offered a reward of ten millions of sesterces for his head, he boldly replied, "Whoever brings me Nero's head shall have the possession of mine." This daring and disinterested leader proclaimed Sergius Galba emperor. Galba, venerable by his age, and pre-eminent for wisdom and courage, was then governor of Spain; and though he was at first unwilling to occupy such a dangerous elevation, yet he was induced to join his forces with those of Vindex.

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* See Ecclesiastical History, Vol. VIII. p. 305.

No sooner did Nero hear of Galba's resolution, than he rent his garments, and swore that he was undone. He threatened to massacre all the governors of provinces, to murder every Gaul, to poison the senate, burn the city, and turn adrift the lions among the people. The absurdity of these threats was equalled only by the folly which was exhibited in his preparations to execute them. Instead of raising armies, and providing for their equipment, he constructed waggons for the easy conveyance of his musical instruments, and he equipped his concubines in the drapery of Amazons. The spirit of insurrection in the mean time was quickly propagated among the legions in Germany, Africa, and Lusitania. Virginius Rufus, who commanded on the Upper Rhine, hesitated for a while to take any active part, and during that time his legions without his knowledge attacked and defeated the Gauls with great slaughter. Mortified at this circumstance, Vindex put himself to death; but distressing as this event was to the insurgents, it was attended with no general consequences. Nero had so completely abandoned his cause, that he provided himself with poison, and prepared to make his escape to Egypt. His confidential servants were sent off to equip a fleet at Ostia; but when Nero requested the tribunes and centurions to accompany him, he could not find a single person to follow his fortunes. Agitated and perplexed, he retired to his couch; but waking in the middle of the night, and finding that his guards had deserted him, he sent for his friends to obtain their advice. No friend, however, was to be found. He went from house to house; but every door was shut against him. He besought one of his gladiators to take away his life; but no hand would raise itself to dispatch the low and despicable tyrant. Without a friend, and unable to find even an enemy, he was on the eve of plunging himself into the Tiber, when Phaon, one of his freedmen, offered him his country house as a place of refuge. Nero gratefully accepted the offer, and, attended by four of his domestics on horseback, he made many escapes, and at last reached the back of Phaon's house, which he entered by a small hole in the wall. When Nero was here reposing upon a wretched pallet, and sustaining himself with brown bread and a cup of water, the senate were declaring Galba emperor, and condemning their oppressor to suffer the rigour of the ancient laws. When he learned from one of Phaon's slaves that he was thus to die, and that he was to be scourged to death with his body naked, and his head fixed to a pillory; and when he heard the soldiers actually approaching to the house, he planted a dagger at his throat, and contrived, with the aid of his secretary, Epaphroditus, to inflict a mortal wound. One of the centurions attempted in vain to stop the blood with his cloak; and Nero expired in the 32d year of his age, and the 14th of his reign.

Nero kills himself, A. D. 68.

Galba declared emperor, A. D. 68.

Although Galba obtained the imperial power under circumstances the most favourable, yet being in the 72d year of his age, he wanted that strength of frame which the arduous duties of his situation so imperiously demanded. An attempt to assassinate him, and a partial revolt in his own army, conspired with the death of Vindex, to make him repent of his elevation; and it is said that he seriously thought of putting an end to his existence. When he heard, however, of the death of Nero, he assumed the title and badges of power.

During Galba's journey towards Rome, an event occurred which displayed the severity more than the justice of the emperor. A body of sailors, to whom Nero had promised certain advantages, assembled round Galba about three miles from Rome, to request a fulfilment of that promise, and urging it in a disrespectful manner, and even taking up arms, Galba dispersed them with a body of horse, and killed no fewer than 7000. When Galba was settled in Rome, he began by dismissing the German cohort, by replenishing the exhausted exchequer, and by putting down those vices which had polluted the preceding reign. Under the system of economy which was now pursued, many acts of meanness and even of avarice were observed; and the people, accustomed to partake in the splendid shows and prodigalities of their emperors, had neither virtue to admire, nor patience to endure, the retrenchments of Galba. His popularity was slightly retrieved by the public execution of Locusta, and various other instruments of Nero's cruelty, who were dragged in fetters through the city; but this act of justice was again neutralised by the pardon of Tigellinus and Helotus, who are said to have procured it by bribes of enormous magnitude, even though the people cried aloud for vengeance upon those atrocious murderers.

The Roman legions in different provinces of the empire, being bound by no tie to the interests of Galba, exhibited various symptoms of disaffection. The army commanded by Vitellius, an ambitious leader, openly refused to obey any other orders than those of the senate, and even sent a request to that body that they would choose another emperor.

When the news of this commotion reached Galba, he resolved to adopt an heir to the throne, who should have no other claim than his virtues and his talents. Otho urged to Galba his claims to this situation; but the emperor wished to attend only to merit, and fixed upon Piso Lucinianus as his successor. This young man deserved the choice which thus fell upon him; but the senate and the army had not been accustomed to admire the moral and intellectual qualities which formed the ground of Piso's appointment. An opening was therefore left for the ambition of Otho, who resolved to obtain by force that appointment which Galba had refused as a reward for his services. By bribing and haranguing the soldiers, and exaggerating the cruelties and avarice of Galba, he succeeded in a few days in gaining the affection of the soldiers, who proclaimed him emperor, and carried him with their drawn swords into the camp. Galba was confounded with this intelligence, and being deceived by a rumour of Otho's death, he rode into the forum, accompanied by several of his followers, when a body of Otho's cavalry attacked the imperial party. Though at first irresolute from the flight of his adherents, Galba recovering his energy bent forwards his head on the approach of the assassins, and commanded them to strike it off if it would be of advantage to the people. This command was speedily obeyed, and his head, fixed on the point of a lance, was carried in triumph round the camp of Otho. The new emperor, like all his predecessors, began his reign with acts of clemency and justice. Though Marcius Celsus had been the favourite of Galba, and had adhered to the cause of his master, yet Otho raised him to the highest honours as a reward of his fidelity. He next gratified the just desire of the people by putting Tigellinus to death, and by restoring the estates of all those whom that monster had banished or plundered.

The legions of Vitellius, whom that general had attached to his interests by great promises as well as by actual presents, proclaimed him emperor, and spread terror throughout the capital. Otho was desirous of making some compromise with his rival; but this offer being rejected, he marched from Rome at the head of a large but undisciplined army. The army of Vitellius, consisting of 70,000 men, was commanded by Valens and Cæcina. Vitellius remained in Gaul to bring up the rest of his forces; but so great was the desire of both parties to engage, that in the course of three days one battle was fought at Placentia, another near Cremona, and a third at Castor, in all which Otho was successful. Valens and Cæcina having united their forces, and received fresh supplies, attacked Otho's army near Bedriacum, and, after a well-contested battle, they succeeded in putting it to flight, and pursued the fugitives with great slaughter to Bedriacum. Otho, whom his minions would not permit to be present at the battle, waited with great uneasiness for its issue. A soldier, who had escaped from the engagement, brought the first news of it to the emperor; but when every person persisted in discrediting his story, this brave man threw himself upon his sword, and expired at the emperor's feet. Otho instantly declared that he would sacrifice no more of such heroes in such a contest, and exhorting his followers to yield peaceably to Vitellius, he put an end to his own life.

After the battle Vitellius was declared emperor by the senate, and having pardoned the adherents of Otho, he travelled to Rome in all the splendour and magnificence which he could command. While he was sitting in painted galleys, bedecked with garlands and flowers, and feasting on every delicacy which could be commanded, his soldiers were plundering in all directions, and without any restraint. He entered Rome as if it were a conquered city, and the senate and people marched before him as if they had been the prisoners taken in his last battle. After haranguing the senate and the people, and receiving the homage which his liberal promises had drawn forth, he quietly settled himself in his palace, to enjoy the pleasures which his gluttony and luxurious habits had rendered the chief happiness of his life. While the vessel of the state was entrusted to the lowest and vilest management, and the soldiers forgetting the art of war amid their unrestrained debaucheries, Vitellius was regaling himself with costly viands; and had learned the art of renewing the pleasure of his meals, by disgorging the food which had already administered to his appetite. Self-invited he breakfasted with one of his subjects, dined with another, and supped with a third; and the influence of his courtiers depended on the frequency of their entertainments, and the skill with which they were managed. A dinner which was given to him by his brother Lucius on his arrival in the capital, consisted of 2000 dishes of fish, and 7000 of fowl. One of the dishes, called the shield of Minerva, was an olio compounded of the sounds of the fish named scarri, the brains of woodcocks and pheasants, the tongues of rare birds, and the spawn of lampreys from the Caspian.

Not content with the gratification of his appetite, Vitellius began to derive pleasure from his cruelties. Even those who were fed with him in the same stall he sacrificed without compunction; and when he went to see one of his parasites in a raging fever, he put poison into a cup of water, and administered it with his own hands. The monster even avowed that he derived pleasure from the torments of his victims. On one occasion, when he had sentenced a father to death, he executed his two sons along with him for begging the life of their parent; and when a Roman knight was dragged to execution, and expected to ward off the blow, by declaring that he had made the emperor his heir, Vitellius obtained a sight of the deed, and having found that he was only joint heir with another, he executed both, in order that he might obtain the property.

Vespasian proclaimed emperor.

These intolerable deeds at last roused the abject Romans. The legions of the east began the revolt; and Vespasian, while he was carrying on the siege of Jerusalem, was proclaimed emperor of Rome. The legions in Mœsia and Pannonia declared for Vespasian, and without his own consent he was proclaimed emperor at Alexandria. Declining the high honour which was thus offered him, Vespasian was compelled by his army to accept of it, and assembling his officers, it was resolved that his son Titus should conduct the war in Judea; that Mutianus should enter Italy with the greatest number of his legions; and that Vespasian should levy a new army in the east.

Vitellius defeated.

When Vespasian's army entered Italy under the command of Antonius Primus, Vitellius made considerable preparations for resistance. His army, commanded by Valens and Cæcina, met the troops of Vespasian near Cremona, and, when a battle was expected, Cæcina went over to Vespasian. The army imprisoned Cæcina, and attacked Antonius; and the battle, which lasted all night, was renewed in the morning, when, after a sharp conflict, Vitellius's army was defeated with a loss of 30,000 men. The routed troops, taking refuge in Cremona, liberated Cæcina, and, through his intercession, were forgiven by the conqueror. The approach of Vespasian's army to Rome was opposed by a few troops who guarded the passes of the Appennines; but when Vitellius heard of the revolt of his fleet, he offered to Vespasian to resign the empire. At this crisis one Sabinus seized the capitol; but Vitellius's soldiers laid it in ashes, and took Sabinus, who was soon after put to death.

Antonius, inattentive to the messages and offers of Vitellius, advanced towards Rome. He attacked it on three sides, drove the besieged into the city, and slaughtered them in great numbers. The wretched and unprincipled populace celebrated the riotous feast of the Saturnalia, at the time that this bloody drama was performing in the city; and while the besiegers were slaughtering, and slaughtered by turns, the citizens were occupied with drunkenness and feasting.

And killed.

Amid this desolation of vice, Vitellius wandered about forsaken even by his slaves. He at last took shelter in some sequestered hiding-place, from which he was soon taken by the victorious enemy. The miserable emperor, in the expectation of protracting his existence, requested that he might be kept in prison till the arrival of Vespasian, as he had important secrets to communicate to him. His appeal, however, was in vain. The soldiers binding his hands, and putting a halter round his neck, led him half naked into the forum, loading him with curses and reproaches. They tied his hair backwards, and put the point of his sword beneath his chin to prevent him from hiding his face. Some threw mud upon him, and others struck him, while some ridiculed the redness of his face, and the magnitude of his belly. Having reached the place of execution, they killed him by blows, and, dragging the body through the streets, they tossed it into the Tiber. Thus terminated the eight months reign of Vitellius, when he had reached the 57th year of his age. Availing themselves of the opportunity for plunder, the soldiers pursued the fugitives into houses and temples, and committed every species of cruelty and rapine.

No sooner, however, did Mutianus, the general of

Vespasian, arrive in Rome than these atrocities ceased, and the metropolis resumed its usual tranquillity. The senate and the army concurred in declaring Vespasian emperor; and messengers were sent to him in Egypt to request him to return. In the mean time Claudius Civilis, who had a command in Germany, revolted, and after maintaining a warlike attitude for some time, and resisting the arms of Cerealis, Vespasian's general, he was at last obliged to make peace with his country. These events were followed by an irruption of the Sarmatians, who passed the Iser, and with the rapidity of a torrent overran the country, destroyed several garrisons, and routed an army commanded by Fonteius Agrippa. Rubrus Gallus, however, succeeded in driving them back into their settlements, in which they were for a while retained by the influence of forts and garrisons.

Vespasian enters Rome.

Having intrusted Titus with the siege of Jerusalem, Vespasian set off for Rome; and he was met many miles from the city by the senate, and one-half of the inhabitants, who for the first time expressed a sincere delight in having an emperor of high principle and tried virtue. While Rome was thus made happy by the succession of Vespasian, his son Titus carried on the war in Judea, which he brought to a close by the total destruction of Jerusalem, as described in our history of the Jews. Titus, therefore, returned in triumph; and the triumphal arch which was erected at that grand celebration exists almost entire in modern Rome. The Romans were justly proud of a prince, who had exhibited all the qualities of a governor, and all the heroism of a soldier; and the metropolis of the world was destined to enjoy, at least during two reigns, the blessings of a profound peace.

Having quieted every commotion, Vespasian had the satisfaction of shutting the temple of Janus, which had been open for six years; and he devoted himself to consolidate the happiness of his people by moral as well as political reformations. He restored the ancient discipline of the army. He shortened and improved the proceedings in courts of justice; and it has been said, that during his long reign no individual suffered from an unjust or a severe decree. Vespasian extended his fostering arm to the arts and sciences, and to the restoration of the public buildings, and the improvement of the city. He settled 100,000 sesterces on the teachers of rhetoric. He patronised Josephus, the Jewish historian, and Quintilian the orator; and Pliny the natural historian was held by him in the highest regard. He patronised both the fine and the useful arts; and he invited to his capital, and took under his patronage, the most celebrated masters and artificers from every part of the world. He restored the Capitol to its original splendour; he built the celebrated amphitheatre, whose ruins still attest its former grandeur; and he founded several new cities, and repaired others that had suffered from the devastations of his predecessors. The clemency of Vespasian was not less than his wisdom. He provided a match in a noble family for the daughter of Vitellius his enemy, and he himself gave her a handsome dowry; and when plots were organised against him, he refused to punish the conspirators. The only exceptions to this mild and forgiving temper occurred in the case of Julius Sabinus, who had proclaimed himself emperor at Vitellius's death. This rash commander, after being defeated by Vespasian's army, concealed himself for nine years in a cave, where he was attended by his faithful wife Empona, who provided for all his necessities. Sabinus was at last discovered, and carried prisoner to Rome; but though powerful application was made in his behalf, yet Vespasian could not be induced to extend his mercy to a man whom he had already dreaded as a rival.

The character of Vespasian required some abatements to be brought down to the ordinary level of humanity; and these were soon discovered in his avarice and rapacity. He revived taxes that had fallen into disuse; he is said to have drawn profit from the purchase and sale of commodities; and he has been loaded with the more serious charge of sharing in the plunder of avaricious governors, whom he had set over the provinces. For the taxes which he levied, however severe and absurd they may have been, an excuse has been easily found in the exhausted state of the revenue when he came to the throne. We are unwilling, therefore, to admit the charge of his sharing in the rapacity of his governors; for it is an undoubted fact, that he took the greatest precautions to provide for the safety of his remotest dominions. And when we consider that only two insurrections took place in his reign, it is not probable that his people were unjustly taxed, or his provinces rapaciously governed. These insurrections were confined principally to the Alani, a rude tribe, who, quitting their deserts, passed into Media and Armenia, and defeated Tiridates with great slaughter. Titus, however, having been sent to punish them, they retired to the river Tanais, from which they came. During the reign of Vespasian, Petilius Cerealis and Julius Frontinus subjugated a considerable part of Britain; and Agricola, who went out towards the end of Vespasian's reign, completed the conquest of the island, as has been stated under that article.

After a reign of ten years, Vespasian was seized with an illness at Campania, which soon carried him off, amid the tears of a people whom he had benefited, and who sincerely loved him in return.

After some slight opposition from his brother Domitian, who alleged that his father's will had been altered, Titus was declared emperor. Though in his youth he was fond of pleasure and dissipation, yet no sooner did he ascend the throne, than he became a pattern of regularity and moderation. His generosity and love of justice, his hatred of informers, his anxiety to prevent dissensions, his obliging disposition, and his readiness, on all occasions, to do good, procured for him the enviable appellation of the Delight of Mankind. The celebrated exclamation of his having lost a day, is said to have been made when he recollected in the evening that on that day he had done nothing to promote the good of mankind.

The great eruption of Vesuvius, in which Pliny the naturalist lost his life, (See PLINY, vol. XVI. p. 656.) happened in Titus's reign; and about the same time a fire raged in Rome for three days, and was followed by a pestilence which carried off 10,000 men in one day. This disaster, which the emperor did all in his power to repair, was followed by the victories of Agricola in Britain, which we have already detailed in that article.

In consequence of a violent attack of fever near Rome, Titus was carried off in the forty-first year of his age, and the third of his reign. He was succeeded by his brother Domitian, who was suspected of having administered poison.

Domitian began his reign with the character of a liberal, just, and humane prince. He refused legacies that had been left him because the testator had children of his own. He sat whole days in revising the sentences of the ordinary judges; and he detested cruelty so much that he forbade the sacrifice of oxen. He furnished the libraries which were burnt with new books, and even sent persons to Alexandria to transcribe MSS. that had been lost. These fair promises, however, were soon blighted. His mind became engrossed with the pursuits of archery and gaming, and his principal ambition was in entertaining the public with extensive exhibitions; and presiding in ostentatious pomp, for the purpose of distributing rewards. His solitary hours were spent in killing flies, and stabbing them with a bodkin; and when one of his servants, Vibius, was asked if the emperor was disengaged, he is said to have replied, that he was not even occupied with a fly. His next passion seems to have been for a military reputation, which led him to envy the glory of his generals. The success of Agricola in Britain in overcoming Galgacus, and determining the insular nature of the country, and in discovering and subjugating the Orkneys, particularly called forth his envy. He recalled him to Italy, under the pretence of appointing him to the government of Syria; but upon his return, he was received with coolness, and having sometime afterwards been taken ill in retirement, where he died, Domitian was suspected of having hastened his death. In order to make himself a great general, the emperor marched into Gaul on a pretended expedition against the Catti, but though he never saw an enemy, he took to himself the honour of a triumph, and entered the capital at the head of a number of slaves whom he had decked in the habiliments of Germans.

In this condition of the empire, the Sarmatians, aided by several Asiatic tribes, made a formidable irruption into it, and cut off a Roman legion with its general. The Dacians, under the guidance of their king Decebalus, were even more successful, and defeated the Romans in many engagements. The energies of the state were at last roused, and the barbarians driven back. Domitian, elated with the result, entered Rome in triumph a second time, and assumed the name of *Germanicus*, from having subdued a people whom he never met in the field.

Satiated with military renown, he began now to glut himself with cruelties.* He persecuted the Jews and Christians with unrelenting severity; and his profusion and avarice led him to sieze the estates of every person against whom he could fabricate the most trivial charge. A conspiracy was soon formed against him, and he was assassinated, after considerable resistance, by Stephanus the comptroller of his household, who was himself slain on the spot by some of the officers of the guard.

As Domitian, who was the last of the Cæsars, left no heir to the throne, the senate, dreading the influence of the army which had been attached to the late emperor, appointed Cocceius Nerva his successor, on the very day on which Domitian was slain.

Cocceius Nerva was descended of an illustrious family, and was by birth a Spaniard. He obtained the empire at the advanced age of sixty-five years, and having been chosen by the senate solely from their experience of his talents and his virtues, no doubt was entertained of his doing honour to his imperial elevation. The horrors of the preceding reign induced Nerva to rule his subjects with an excess of clemency and indulgence. When he accepted of the throne, he swore that no Roman senator should be put to death during his reign. He was liberal in his gifts to his friends, and he sold all his gold and silver plate to enable him to continue his generosities. He took off a severe tax upon carriages; he removed the imposts which had been laid on by Vespasian, and he restored the properties which had been seized by Domitian. Besides making many good laws, he united, more than any other sovereign, a system of retrenchment and economy, with acts of well-judged liberality. He allowed no statues to be erected to himself. He sold all those which had been raised to Domitian, and converted into money the gaudy robes and luxurious furniture of the palace.

Notwithstanding the benevolence and mildness which characterise the life of Nerva, he began to experience that malignity which vice never fails to exhibit against virtue. A dangerous conspiracy was formed against his life by Calpurnius Crassus; but though the senate were desirous of treating the conspirators with rigour, Nerva would allow no other severity to be inflicted than that of banishment.

A. D. 97.

This unwillingness to punish the guilty promoted no doubt another insurrection which had been organised against Nerva among the Prætorian bands, under Casparius Olianius, on the plea of revenging the death of Domitian. Nerva used all gentle means to put an end to the mutiny. He even presented himself to the insurgents, opened his breast, and desired them to take his life rather than to involve their country in fresh calamities. Unawed by his courage, the mutineers seized upon Petronius and Parthenius, and slew them before the emperor. They then compelled Nerva to approve of their sedition, and to thank the Prætorian bands for their fidelity. These events, though personally disagreeable to Nerva, turned out most favourable for the empire. The turbulence and injustice which the cohorts had now evinced induced Nerva to look around him for a colleague, who might afford him his assistance and advice in the government of the empire. Having no private objects in view, he set aside all his own relations and fixed upon M. Ulpius Crinitus Trajan, an entire stranger to his family, who then held the government in Upper Germany.

Nerva adopts Trajan as his colleague.
A. D. 97.

Having performed the usual formalities, Nerva sent ambassadors to Cologne, where Trajan then resided, informing him of his choice, and requesting his presence and assistance in checking the turbulence of the soldiers. After punishing Caspanius Olianius, Nerva died of a fever, which was brought on by a violent passion, into which he threw himself with one of his senators.

Death of Nerva.
A. D. 98.

When Trajan was informed of the death of Nerva, he returned to Rome with his army, in which he maintained a discipline which had long been unknown among the Roman legions. The provinces through which he passed were neither ravaged by the soldiers nor taxed by the generals; and the new emperor entered Rome without pomp or circumstance, attended by the officers of state, and followed in peaceful procession by his soldiers. Trajan, though born in Seville, was descended of an Italian family. His father had been raised to the rank of a patrician by Vespasian, and after various successful expeditions on the Euphrates and the Rhine, in which his son accompanied him, he had been honoured with the consulship, and with a triumph. In this way Trajan acquired in early life, a very considerable reputation in war. When the command of the army in Lower Germany was given him, he lived in the most simple and unassuming manner. He performed long marches on foot along with his troops, and shared with them all the dangers and fatigues of war. He knew all the old soldiers by their own names, and conversed with them in the most familiar manner. Before he retired to rest he inspected the camp personally, and convinced himself of the vigilance of his sentinels and the security of his army. To these qualities as a soldier, he added the most amiable modesty and mildness of disposition, and he united in his character all those moral and intellectual qualifications, and all that experience in war and personal bravery which history generally records as the gifts of many different individuals. His personal appearance corresponded with the symmetry of his mind; and when he entered Rome in the vigour of manhood, he inspired his subjects with a respect and admiration which they never ceased to attach to his name.

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* An account of these and of various other particulars of his life will be found under our article Domitian, vol. viii. p. 42.

Trajan overcomes the Dacians.

Trajan had no sooner ascended the throne, than he was called upon to check the insolence of the Dacians, who had ravaged the Roman empire during the reign of Domitian, and who now claimed from the Roman people a tribute which the cowardice of that emperor had induced him to offer. At the head of a powerful army Trajan marched towards Dacia, and overawed the barbarians by his sudden appearance upon their frontier. The treaty, however, into which they were thus compelled to enter, was speedily broken by their king Decebalus. After throwing a bridge over the Danube, Trajan entered Dacia, and brought Decebalus to a general action, in which the Dacian army was completely routed; and their king, despairing of success, put himself to death. In this battle, which reduced Dacia to a Roman province, the slaughter was so great, that linen was wanted in the Roman camp to dress the wounds of the soldiers. On the return of Trajan to Italy he entered the capital in triumph, and the rejoicings for the victories were continued for 120 days.

A. D. 103.

The duties of peace now demanded the attention of Trajan. He erected many public works; he opened communications between the different parts of his provinces; he established many colonies, and he laid up stores of corn and provisions to save the capital from the calamities of famine. In order to commemorate his victories, Apollodorus erected the magnificent column which still exists at Rome under the name of Trajan's column. Unfortunately for the future reputation of this great emperor, he was persuaded about the 9th year of his reign to harbour a dislike of his Christian subjects. His regard for the national religion, and a law which had been enacted against societies that dissented from it, induced him to sanction those cruelties which form a blot upon his name, and which we have already described in our article Ecclesiastical History. The Armenians and Parthians having about this time thrown off the Roman yoke, Trajan marched into Armenia, which had been abandoned by its sovereign, and having taken possession of the kingdom, and captured the king himself, he marched into the Parthian territories, where he obtained the most signal successes; and after conquering Syria and Chaldea, he took possession of Babylon itself. The enemy made a stand when he reached the Euphrates; but having caused boats to be constructed in the adjacent mountains during the night, he brought them suddenly to the river side, and crossed his army in the face of the enemy, who disputed the passage with unusual vigour. Quitting the Euphrates, he traversed countries which had never been trodden by the foot of a Roman soldier; and he seems to have taken a peculiar delight in following that line of march which Alexander had pursued before him. He crossed the rapid Tigris, and took the city of Ctesiphon, and after subjugating the districts of Persia bordering on that river, he marched in a southerly direction towards the Persian Gulph, where he subdued the sovereign of a territory formed by the channels of the Tigris. The inclemency of the weather and the inundations of the river had nearly cut off his army; and suffering from the scarcity of provisions, and experiencing the infirmities of age, he returned along the Gulph of Persia, with the view of punishing that kingdom, which had revolted during his absence. He began this war of vengeance by laying Edessa, in Mesapotamia, in ashes; and he not only reconquered all the revolted states, but he added to the Roman empire many of the richest kingdoms of Asia. Having met with a repulse before the city of Atra in Arabia, Trajan concluded that the time had now arrived for limiting his conquests, and putting them under proper management. Returning to Ctesiphon, he crowned Parthamaspates king of Persia. He gave a king to the country of Albania near the Caspian, and he placed governors and lieutenants in the other provinces. Having resolved to return to Italy, he left Adrian in the command of all his forces in the east, and advanced towards Rome, where the most splendid preparations were made to adorn his triumph. Exhausted, however, with the fatigues of war, he was taken ill in the province of Cilicia, and finding himself unable to travel any farther, he was carried to Selinus, where he died of a flux in the 64th year of his age and the 20th of his reign. His ashes were carried to Rome and deposited under the lofty column which bears his name. During his indisposition at Selinus, he was constantly attended by his wife Plotina, who, from a knowledge of her husband's dislike to Adrian, is supposed to have forged the will in which that general was appointed his successor.

A. D. 114.

Persecutes the Christians.
A. D. 114.

Adrian, who was introduced to the Roman armies by Plotina as the adopted son of her husband, was descended of a Spanish family, and was born at Seville, the native place of Trajan. He abandoned the Eastern conquests of Trajan, and limited the Roman empire by the Euphrates. He returned to Rome in the year 118; and after a reign of twenty years, he died of a dropsy in 138. A full account of the events of his reign has already been given in our account of his life.*

Adrian was succeeded in the empire by Marcus Antonius Pius, whom he had adopted some time before his death. His reign, which lasted twenty-eight years, was marked with few striking events; but it will be ever distinguished in the annals of Rome by the public and private virtues which exalted his character. He died of a fever in the seventy-fifth year of his age, and the twenty-third of his reign, the distinguishing events of which have been already detailed in our biographical account of him.†

This excellent emperor was succeeded by his son-in-law, Marcus Aurelius Antoninus, who had married his youngest daughter. After a reign of twenty years, the history of which is given in another part of our work,* he died at the age of fifty-nine.

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* See Adrian, Vol. I. p. 150.

† See Antoninus Pius, Vol. II. p. 222.

This wise and good emperor was succeeded by his son, L. Aurelius Antoninus Commodus. This prince was of a weak and timid disposition, and his mind was gradually corrupted by the vices of his attendants. As he advanced in life, he became still more debauched; and his vices and his cruelties are of such a character as to be placed without the limits of history. He is said to have cut in two a corpulent man when walking in the street, in order that he might see his entrails fall on the ground. He thrust out the eyes, and cut off the legs of persons whom he encountered in his rambles. He murdered some because they were badly dressed, and others because they were slovens. He affected to have great skill in surgery, especially in blood-letting; and when he visited some of his patients, he did not scruple to cut off their ears and noses. His debaucheries are reported to have exceeded all bounds, and to have exhausted every variety of licentiousness. He is said to have possessed great skill in archery, and to have performed many wonderful feats. His strength was excessive; and from this cause he was ambitious of being called Hercules. Hence he adorned his shoulders with a lion's skin, and carried in his hand a knotted club. He is stated to have run an elephant through with his spear, and to have killed a hundred lions, one after another, and each by one blow. He appeared naked in public, fought with the common gladiators, and came off conqueror seven-hundred and thirty-five times; in consequence of which, he used to subscribe himself the conqueror of a thousand gladiators. When the senate had granted him, at his request, divine honours, he strewed on his head such a quantity of gold dust, that it glittered in the sun-beams as if encircled with a glory.

The military events of Commodus's reign were disgraceful to the Roman name. After the death of his father, he concluded a peace with the Marcomanni and Quadi, on very unfavourable terms; and he agreed to abandon all the castles and fortresses which the Romans held in their country, excepting those that were within five miles of the Danube. Arrangements equally unworthy of Rome were made with the other nations of Germany, whom his father had subjugated; and, in some cases, he purchased a peace by large sums of money.

A conspiracy was now formed against the life of Commodus, by his sister Lucilla, who was aided by many of the most distinguished senators. The emperor was attacked on his way to the amphitheatre, in a dark passage; but Claudius Pompeianus, to whom the dagger was entrusted, instead of plunging it into his breast, held it up, and exclaimed; "this present the senate sends you," which gave the guards time to rescue their master. The conspirators were seized and put to death, and Lucilla was exiled to Capreæ, where she was soon after murdered.

Perennis, the favourite of the minister of Commodus, had imitated so successfully the ambition of his master, and had exercised such intolerable oppression, that he was torn in pieces by the military. He was replaced by Cleander, a freedman, who exceeded his predecessor in his enormities; and who even put up for public sale every office in the state, and even the lives of the innocent and the guilty.

Revolt of Maternus.
A. D. 187.

A revolt of a very unusual kind took place about this time at Rome. A common soldier, of the name of Maternus, along with several others who had deserted from their legions, formed a rebel party which was gradually increased by the banditti from different provinces. Their power encreased to such a degree that they took the strongest cities by storm, and plundered many parts of Spain and Gaul. An army under Pescennius Niger, was sent against the insurgents; but Maternus, finding himself unable to cope with a disciplined force, divided his followers into small bands, and marched secretly to Rome by different routes. His object was to murder the emperor at an annual festival, and to seize upon the supreme authority. All the different bands arrived undiscovered in the capital; and some of them had already insinuated themselves among the emperor's guards; but they were fortunately not faithful to their leader. Some of them betrayed Maternus, who was immediately seized and executed.

A plague at Rome.

Rome was at this time afflicted with one of the most dreadful plagues that had ever been known in Rome. It continued for two or three years; and was so fatal, that it carried off two thousand persons in one day. An alarming fire, kindled by lightning, consumed a considerable part of the city; and these calamities were followed by a famine, which Cleander is said to have created by hoarding all the corn which he could purchase; while others ascribe it to Papirius Dionysius, who had the charge of supplying Rome with corn, and who wished to excite the people against Cleander. The mob, however, blamed the detested favourite; and having risen against him, they flocked to the palace, and demanded his head. Cleander ordered the Prætorian guards to charge the crowd, many of whom they slaughtered; but the city guards taking the side of the people, the Prætorian troops were put to flight. When Commodus heard of the uproar, and learned the cause of it, he ordered the head of Cleander to be cut off and thrown to the populace. A conspiracy was now formed against the emperor himself, by Laetus, the captain of the guards, Eclectus the chamberlain, and Martia, his favourite concubine. Martia had received information that the emperor had resolved upon her death; she therefore organised the conspiracy against him, and administered poison; but when the poison was found not to operate quickly, the wretched victim was strangled by a wrestler.

Commodus strangled.
A. D. 192.

When the death of Commodus was publicly announced, the senate declared him an enemy to the public, demolished his statue, and ordered his body to be cast into the Tiber. The conspirators, however, prevented this outrage from taking place, by stating that Commodus had already been buried.

Pertinax raised to the empire.
A. D. 193.

Commodus was succeeded by Publius Helvius Pertinax, whom the conspirators had fixed upon to supply his place. This remarkable person had passed through such varieties of condition, that he received the title of the tennis-ball of fortune. Descended from an obscure family; and either a slave, or the son of a manumitted slave, he followed, for some time, the profession of drying wood and preparing charcoal. He had received, however, a considerable portion of learning; and after keeping a little shop in the city, he became a school-master, and actually taught the Greek and Roman languages in Etruria. He then followed the profession of the law, and afterwards entered upon a military life, when he distinguished himself so highly by his valour and intrepidity, that he was made a captain of a cohort in the Parthian war. After passing through the usual gradations of preferment, in Britain and Mæsia, he obtained the command of a legion under Aurelius. He was afterwards made consul by Aurelius for his eminent services. He was next intrusted with the government of Mæsia, and he was at last made governor of Rome. In the reign of Commodus he was sent into exile; but he was soon after recalled and selected to reform the abuses in the army in Britain. During a sedition which took place among the legions, he was left for dead among the slain; but having recovered from this calamity, he punished the mutineers, and restored the discipline of the army. In Africa, to which he was next removed, the sedition of the troops had nearly proved fatal to him; and being now fatigued with a life of such labour and danger, he returned and lived in retirement in Rome. Commodus, however, made him præfect of the city, and he filled this situation when Laetus entered his apartment, and announced to him that he was emperor of Rome. Pertinax, unwilling to accept of such a trust, urged the pleas of old age and increasing infirmities; but his refusal was not listened to, and he was immediately carried to the camp and proclaimed emperor.

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* See Antoninus Marcus Aurelius, Vol. I. p. 223.

Pertinax declared emperor.
A. D. 193.

The anticipations which had been formed of Pertinax, were in no respect disappointed. By strict discipline and wise regulations, he restrained the licentiousness of the Prætorian bands, and protected the citizens against the overbearing insolence with which they had so long treated them. He punished the wretches who had a share in corrupting the late emperor, whose ill-gotten property he sold for the benefit of the public. He sold as slaves most of the buffoons and jesters of Commodus; particularly those who had obscene names. He attended all the meetings of the senate; and such was his devotion to business, that the meanest applicant could at any time command an audience of him. He melted the silver statues which had been erected to Commodus; and having sold his concubines, horses, and arms, he raised so large a sum as to enable him to abolish all the taxes which that emperor had laid upon the rivers, harbours, and roads in the empire.

The reformation which Pertinax had introduced among the Prætorian bands, excited against him, as might have been expected, the hatred of these insolent soldiers. They therefore resolved to depose him; and having declared an ancient senator of the name of Maternus emperor, they attempted to carry him to the camp to be proclaimed. Unwilling, however, to concur in such a design, he escaped from their power; and having first gone to the emperor, he afterwards fled from the city. Undismayed by this refusal, the insurgents nominated another senator of the name of Falco, who was more compliant; and whom the senate would have ordered for execution, had not Pertinax interposed his authority, and repeated his resolution, that no senator should suffer in his reign.

The Prætorian soldiers, however, were determined to gain their object; and they openly avowed their design of seizing upon the emperor. Having assembled, therefore, in the streets, they marched to the palace. Terrified at their approach, many of the emperor's attendants forsook him, while those who remained steady, urged him to fly for protection to the people. He scorned this advice, and marching to face the rebels, and advancing in the midst of them, he boldly asked them if they who were bound to defend the emperor had come to betray him and to shed his blood. Confounded with this act of personal heroism, the rebels began to retire, when one Thrasinus, a Tungrian, struck him with his lance on the breast, and exclaimed, "the soldiers send you this." This pious and good emperor, muffling his head in his robe, and calling upon Jupiter to avenge his death, sunk down and expired of a multitude of wounds. Several of his faithful attendants, among whom was Eclectus, were slain in their attempt to defend him; and his son and daughter owed their life to the circumstance of their not residing in the palace.

Rome was now placed in the most deplorable condition. Her unprincipled population had shown their submission to any emperor, however detestable and cruel, provided he administered to their own pleasures; and they had now reached that acme of vice, at which a good man was considered unfit, as well as unable to govern them. It was not to be wondered at, therefore, that the empire was soon exposed to sale by a public proclamation of the army. Only two offerers appeared for the sceptre of the world. Sulpicianus, prefect of the city, and son-in-law to Pertinax, got first to the camp, and made liberal promises to the soldiers. He was, however, soon supplanted by Didius Julianus, an eminent lawyer, who had amassed an enormous fortune by his avarice. He produced immense sums of ready money, and having been received into the camp by a soldier, and being declared the highest bidder, the empire was knocked down to him. Attended by the conductors of the sale, who amounted to about 10,000 men, Julianus entered the city. Although the people hissed him as he passed, and refused to sanction his elevation, yet the senate concurred with the army, and Didius was acknowledged emperor in the 57th year of his age. Having acquired the imperial diadem by purchase, Didius resolved to use it for his pleasure. He gave himself no trouble about the affairs of state, but resigned himself to indolence and repose. The soldiers, however, began to discover his avarice, and to view him with detestation. He was loaded with curses whenever he left the palace, and, saluted with the appellation of a thief, he was told that he had stolen the empire. The good-natured monarch, however, bore all this with the greatest gentleness and forbearance. He bowed and smiled to those who insulted him, and was always willing to submit to the humours and caprices of the people.

A portion of the Roman spirit, however, seems still to have lingered among the provinces. The governor of Syria, Pescennius Niger, and Septimius Severus, who commanded the German legions, resolved to aspire to the throne. They both held out Pertinax as their model; and Septimius Severus, an African by birth, assumed his name, and vowed to revenge his death. Niger was proclaimed emperor by his troops; and the different kings and potentates in Asia sent ambassadors to acknowledge his title. Content with this homage, he made no efforts to secure the empire, but devoted himself to a luxurious life at Antioch.

Septimius, however, proceeded more cautiously. Having assumed Albinus, who commanded in Britain, as his partner, and secured the strong-holds in Germany, he marched to Rome at the head of his army. At the urgent request of Didius, the senate proclaimed him a traitor; but all the attempts of Didius were unable to organize an effective force, and, perplexed with opposite counsels, he waited the approach of his rival. When Severus had advanced near to Rome, Didius, with the consent of the senate, sent ambassadors to offer him a share in the concern; but when the general rejected this offer, the senate immediately assembled, and having passed a decree depriving Didius of the empire, they proclaimed Severus in his place. Didius was ordered by the senate to be slain, and, when the executioners had performed their office, after great remonstrances and wailing on the part of Didius, they stuck up his head in the court of justice, where he had formerly carried on his professional pursuits.

Severus was now declared emperor by the senate in the 47th year of his age. Before he entered Rome, he ordered the Prætorian soldiers, who had sold the empire, to come out unarmed to meet him. Having no alternative but compliance, they marched out with laurels in their hands to welcome his approach; but Severus, after reproaching them for their crimes, ordered them to be stripped of their military equipments, deprived of the title and rank of soldiers, and banished to the distance of 100 miles from Rome. Severus then made his entrance into the city. The streets were strewed with flowers, and the senate received him with open arms, and granted him every honour and title that he desired, while he in return promised to govern with justice and moderation. In order to secure adherents, he seized all the children of those who occupied situations of authority in the east, and he kept them as hostages for the good conduct of their fathers. He next supplied the city with corn, and hastened to Syria to attack Niger, who still reigned in the east under the title of Augustus. After many obstinate engagements between the rival sovereigns, a decisive battle took place on the plains of the Issus, in which Niger was totally defeated with the loss of 20,000 men. The head of Niger was cut off, and carried on the point of a lance to Severus, who exercised the greatest severity against the adherents of his rival. The Parthians, and several of the neighbouring nations, had taken up arms in defence of Niger; but Severus defeated them in such decisive battles that he put down all his enemies in the east.

Having thus established peace, and even enlarged the empire, Severus resolved to get rid of Claudius Albinus, whom he had assumed as his partner in the empire at a time when he dreaded his influence and power. Under the guise of messengers carrying dispatches, he sent assassins into Britain to murder Albinus; but the general, being informed of their designs, assumed a warlike attitude, and proclaimed himself emperor. These rival leaders met each other in Gaul, where they carried on a vigorous, though an indecisive campaign. A desperate engagement at last took place, which continued from morning till night with variable though equal success. The troops of Severus at last gave way; and he himself falling from his horse, the rival army raised the shouts of victory. A body of reserve, however, under Lætus, one of Severus's officers, who intended to destroy both parties and assume the sovereignty, restored the fury of the battle, and enabled Severus to rally his troops, and make a desperate charge against Albinus. This attack was made with such skill and bravery, that the army of Albinus was pursued into the city of Lyons, and he himself taken prisoner and slain. In place of using this victory with moderation, Severus executed all the senators who were taken prisoners; and he treated with unmanly insolence the bodies of those who fell.

In order to establish himself in the power which he had now acquired, he distributed rewards and honours in the most profuse manner among his troops, and having given the charge of the government to one Plautianus, whose daughter his son Caracalla had married, Severus, accompanied by his sons Caracalla and Geta, undertook an expedition against the Parthians, who had then assumed an hostile attitude on his eastern frontier. In this campaign he subjugated Armenia, and making himself master of Seleucia, Babylon, and Ctesiphon, he subdued the kingdom of Parthia. From Parthia he advanced to the south of Asia, and, after visiting the tomb of Pompey the Great, and granting a senate to Alexandria, he studied with an inquiring eye the various monuments and ruins which even at that time rendered Egypt an object of general interest.

During the absence of Severus and his sons, Plautianus conceived the design of seizing the empire; and no sooner had Severus returned, than Plautianus engaged a tribune of the Prætorian bands, whom he commanded to assassinate both Severus and Caracalla. The tribune lost no time in communicating the intelligence to Severus, who treated it as a plot devised by the enemies of his favourite. The tribune at last requested permission to bring Plautianus to the emperor's apartment, and having informed him that he had slain both Severus and Caracalla, Plautianus was ordered to follow him to the palace. Conducted at midnight to the place of murder, he found Severus encircled by his friends, and ready to receive him. Confounded at the sight, he confessed his designs. The emperor was disposed to pardon him; but Caracalla, heedless of the supplications of the criminal, ran him through the body with his sword.

Severus's expedition into Britain.
A. D. 206.

As the Roman arms had suffered some checks in Britain, Severus resolved to recover the territory which had been lost. After visiting some cities in Italy, and appointing Caracalla and Geta his successors in the empire, he was accompanied by his two sons, and, when he landed in the island, he left Geta in the south, and marched with Caracalla against the Caledonians. Pursuing the inhabitants through their extensive marshes, and their dense forests, he lost about 50,000 men in this toilsome warfare; but his success was such that the enemy sued for peace, and surrendered a considerable part of their country. There is reason to think that Severus did not obtain possession of any part of Caledonia, and that he was never able to make any impression upon the people of that country.

Wall of Severus.

Having conquered the countries bordering on Caledonia, Severus built a wall across the island, extending from sea to sea, from Bowness, or *Tunnocelum*, on the Solway Firth, to Cousin's house, or *Segedunum*, near the mouth of the river Tyne, a distance of 68 English miles. The wall was built of freestone, and had a ditch on its north side. It was twelve feet high and eight broad, and contained a great number of fortresses of different kinds. By this barrier the conquered provinces were protected against the incursions of the Caledonians, and Severus retired to York. Caracalla attempted to murder his father; and the old man was so shocked with the brutality of his son, that he called him into his presence, and offering him a naked sword, exclaimed, "If you are ambitious of reigning alone, imbrue now your hands in your father's blood, and let not the world witness your want of filial tenderness." Caracalla was not greatly disturbed by this reproof. He seems to have prevailed upon the soldiers to revolt, and to proclaim him emperor; but the moment Severus, who had now lost the use of his feet, heard of these steps, he ordered himself to be put into his litter, and demanded the presence of Caracalla, and the tribunes and centurions. Confounded with the energy and boldness of their emperor, they implored his pardon on their knees; upon which he exclaimed, "It is the head that governs, and not the feet." Feeling that his disorder daily gained strength, he called for poison; but his attendants having refused it, he ate to excess, which put an end to his life in the 66th year of his age, and the 18th of his reign.

Death of Severus. A. D. 210.

Though noted for his severity and cruelty, and destitute of the common feelings of humanity, yet Severus has gained a high name for his military talents, his attention to business, and his temperance and simplicity of character. He was fond of literature, and was celebrated by his wit as well as by his learning. He is said to have composed a history of his own reign, which was praised for its correctness and truth.

Caracalla and Geta succeed to the empire.

No sooner were Caracalla and Geta proclaimed emperors by the army, than they displayed the most inveterate hatred against each other. After murdering his brother, and marrying his father's wife, and committing many acts of cruelty, treachery, and folly, of which we have given a full account in his life, Caracalla was murdered by a centurion at the instigation of Opilius Macrinus, in the 29th year of his age, and the 6th of his reign.

Caracalla murdered. A. D. 217.

Macrinus made emperor. A. D. 218.

Macrinus, a Prætorian prefect, and who had been Caracalla's principal general in Mesopotamia, was declared emperor by the army, and their choice was confirmed by the senate. Macrinus, who was a Moor by birth, had reached his 53d year. He was very popular at the commencement of his reign, both from the affability of his manner, and from his having abolished several taxes. His popularity, however, did not last long. His cowardice in purchasing a peace from the Persians by a large sum of money, and his constant affectation of imitating the virtuous Aurelius, irritated the people, and brought him into contempt. In attempting to restrain the licentiousness of the soldiers, he was compelled to adopt some severities of discipline, which incensed the army, and induced them to mutiny. Mæsa, the grandmother of Heliogabalus, who was the natural son of Caracalla, took advantage of this rebellious spirit, and distributing liberal presents among the soldiers, she recommended Heliogabalus to their notice. They accordingly sent for him to the camp, and proclaimed him emperor.

Heliogabalus, who was now only fourteen years of age, was a priest in the temple of the sun at Emea, in Phenicia, and was distinguished by the beauty of his person. The disposition to support his cause had become very strong in Rome; when Macrinus, who had been leading a life of pleasure at Antioch, sent over his lieutenant Julian with some legions to Italy. These troops slew their general, and declared for Heliogabalus. Macrinus now resolved to march against the mutinous legions. The combatants met on the frontiers of Syria, and, after a bloody battle, Macrinus was put to flight. Desirous of getting to Rome, he travelled with secrecy and expedition through Asia Minor; but he fell ill at Chalcedon, and being overtaken by his pursuers, he was put to death, along with his son Diadumenus, after a reign of fourteen months.

Macrinus put to death.

Heliogabalus succeeds to the empire. A. D. 218.

The succession of Heliogabalus to the empire having been ratified by the senate and citizens of Rome, he was invested with the usual titles, and at the age of fourteen put in possession of absolute power. Surrounded by flatterers, who found it their interest to gratify him in all his propensities however wild, Heliogabalus was soon initiated into all the profligacy of the times; and he is described by the Roman historian as a monster of sensuality and vice. All the prostitutes of Rome assembled in his palace, and the most infamous of the mob became the imperial favourites. He appointed his grandmother Mæsa, and his mother Semias his colleagues in the empire; and, in order to dignify the sex, to which he was so much attached, he created a female senate, over which his mother presided, and the object of which was to arrange the fashions which were to prevail in the empire. He next raised to the honours of the consulship his own horse, whom he fed with gilded oats; and he forced his subjects to worship the god Heliogabalus, which was a large black stone of a conical shape. To this deity temples were raised, and the shrines of the gods were plundered to deck that of the newly invented divinity. His prodigality was such, that he considered nothing worth eating that was bought at a moderate price. His supper commonly cost 6000 crowns; and on some occasions so much as 60,000. He dressed himself in gold and purple clothes, and never wore the same dress twice. His apartments were furnished with the richest stuffs, covered with gold and jewels. His mats consisted of the down of hares, or the soft feathers from beneath the wings of partridges; and his carpets were made of gold and silver tissue, and his shoes were covered with precious stones, to attract the notice of the populace.

Annoyed with these excesses, his mother Mæsa, conceiving that she might diminish his power, by sharing it with a colleague, proposed to him to adopt his cousin german, Alexander Severus, and to make him a partner in his throne. Heliogabalus agreed to the request; but was soon desirous of undoing what he had done. The virtues of Alexander, however, had endeared him to the soldiers; and when Heliogabalus attempted to deprive him of the throne, the Prætorian soldiers resented the attempt, and would have killed the emperor as he was walking in his garden had he not saved himself by flight. The seditious spirit however continued; and the soldiers insisted upon guarding Alexander, and upon prohibiting any of the emperor's favourites from contaminating him with their society. Heliogabalus was alarmed with the mutinous spirit of his guards, and made preparations for his death suitable to his general habits. He erected a tower with gold and mother-of-pearl steps, from which he might precipitate himself if necessary. He kept about his person cords of purple, silk, and gold, for the purpose of strangling himself; he provided golden swords and daggers to stab himself with; and he had different poisons kept in boxes of emerald. In this state of mind he suspected the senate of having designs against him, and he banished them from the city; he attempted to poison Alexander, but the mutiny of the soldiers prevented him from carrying it into effect; and when he thus found himself threatened on all sides, he meditated new cruelties against his enemies. The soldiers resolved to put an end to such a system. They followed him into his palace; pursued him from room to room; and at last found him hid in a privy, from which he was dragged into the street, and ignominiously put to death. They attempted to thrust his carcase into a privy; but finding this difficult, they loaded it with weights, and cast it into the Tiber. His mother, and many of the partners of his crimes, were at the same time put to death.

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* See CARACALLA, Vol. V. p. 418.

Alexander Severus was unanimously declared emperor by the senate and the people, and he was every way deserving of that high honour. Though possessed of absolute power at the age of sixteen, yet his mother Mammea, one of his advisers, was distinguished for her alents and virtues, and exerted every nerve to make he reign of her son honourable to himself, and useful s well as glorious for the empire. One of the first teps of Alexander was to reform the abuses of the preeding reign; to punish with severity every magistrate hat took bribes; and to reward all those whose conuct was marked with justice and integrity. The humanity of the emperor was not inferior to his justice. He put down the luxuries of his predecessor, and did very thing in his power to promote morality, and to epress those licentious pleasures which had debased his subjects.

Under his beneficent sway the Christians, who had uffered so many persecutions in Rome, were themelves protected; and in a dispute between the Christans and a company of cooks respecting a piece of public ground, which the one party wished as a place of worship, while the other meant to employ it in the exercise of their profession, the emperor decided in his rescript, "that it was better that God should be worshipped there in any manner, than that the spot should be devoted to drunkenness and debauchery."

The personal accomplishments of this monarch have been highly extolled by historians. He was not only a patron of literature, but he devoted his leisure hours to the study of the Greek and Latin historians, orators, and poets. He was skilled in mathematics, geometry, and music. In painting and sculpture he had acquired great knowledge, and as a poet he is said to have had few rivals.

In the arts of war as well as in those of peace, Alexander was pre-eminent. The tranquillity of the empire having been disturbed by the Persians, Alexander placed himself at the head of his army and marched into the East. He routed the Persians with great slaughter in a decisive battle; he took the cities of Ctesiphon and Babylon, and thus regained the territory which had been lost. When he returned to Antioch his mother Mammea sent for the celebrated Origen, to receive instructions from him respecting the principles of Christianity, and after various communications with her, she sent him back with a proper guard to his native city of Alexandria. The generals of Alexander who commanded in other provinces, were equally successful. Furius Celsus subdued the Mauritanians in Africa; Varius Macrinus obtained great successes in Germany; and Junius Palmatus triumphed in Armenia.

Notwithstanding these successes, however, the empire was overrun by hordes from upper Germany, and the north of Europe, who crossed the Rhine and the Danube in such swarms that they carried consternation even into the heart of Rome. Alexander increased his army and marched against them in person. He obtained various successes over the enemy; but the strict discipline which the state of his troops had rendered necessary, displeased his army, and excited a mutiny among the legions encamped about Moguntia, who had been accustomed to every kind of licence during the corruptions of the preceding reign. They openly declared that they were under the dominion of a woman without liberality, and a boy without spirit; and they announced their design of electing an emperor who needed no assistance on his throne. These dissensions were fomented by an old general Maximinus, who held frequent communications with the troops. Resolved to destroy Alexander, they sent an executioner into his tent, who cut off his head, and put to death his mother and all his friends. As soon as the army heard of his fate, they punished with immediate death all who had been concerned in the murder, with the exception only of Maximinus.

Alexander murdered in his tent. A. D. 235.

Maximinus proclaimed emperor. A. D. 235.

Caius Julius Verus Maximinus, the principal abettor of the sedition against Alexander, was now proclaimed emperor. His father was a Thracian shepherd, and he himself exercised the same humble profession. Having frequently led his countrymen against the barbarians and robbers who infested the plains on which his flocks grazed, he had acquired a knowledge of irregular warfare, and was inflamed with a passion for military glory. He therefore entered the Roman army, where he soon became as remarkable for his courage and discipline, as he was for his strength and gigantic stature. He was nearly eight feet and a half high, and his form was equally strong and symmetrical. He was capable of drawing a load which two oxen could not move. He could break the thigh-bone of a horse by a kick, and struck out its teeth with a blow. He generally ate forty pounds of flesh every day, and drank six gallons of wine without being exposed to the charge of intemperance. Maximinus first displayed his strength at the public games which the emperor Septimius Severus was celebrating on the birth-day of his son Geta. The giant had requested permission to contend for the prizes, but Severus allowed him to combat only with slaves. In running he outstripped sixteen one after the other. He kept up with the emperor on horseback, and after being thus fatigued, he overcame seven of the most active soldiers. These feats of strength induced the emperor to take him into his body guards. In Caracalla's reign he was made a centurion; and in consequence of his good conduct and strict discipline, he was raised to the rank of a tribune. When Macrinus succeeded to the empire, Maximinus refused to serve him, and retired to Thrace, where he purchased some land and carried on some commercial pursuits. He returned to Rome on the accession of Heliogabalus, but the effeminacy of the emperor soon made him quit the court. The emperor Alexander afterwards received him in the kindest manner, and gave him the command of the fourth legion, consisting of new raised troops, which he commanded with great honour against the Germans, having acquired the character of being the bravest and the most virtuous soldier in the Roman army. The ambition of power, or rather the possession of it, seems to have altered his nature. The base ingratitude to Alexander with which he marked the commencement of his new life, was followed by a system of tyranny and brutality which had scarcely been equalled even in the reigns of his most detested predecessors.

His cruelties.

The senate having refused to ratify his election, he determined to reign without their concurrence. He put to death all the senators who were obnoxious to him, and resolved to force an unwilling obedience from every rank in the state. He slew the rich for the purpose of obtaining their estates. He persecuted the Christians; and, ashamed of the obscurity of his extraction, he put to death all those who were acquainted with him in early life. No fewer than 400 persons are said to have been sacrificed to the bare suspicion of their having conspired against his life. They were exposed not merely to death but to torments; and the imperial monster is said to have entertained himself by killing some with blows; by exposing others to wild beasts; by nailing them on crosses, and by enclosing them in the bellies of animals newly slain.

In his military capacity he now showed the same spirit, and his bravery and his skill remained the same. He defeated the Germans in several engagements, and cutting down the standing corn, and laying waste the country with fire and sword for 450 miles round, he wished to impress upon the Germans the punishment of rebellion. The soldiers were deeply attached to him, not only from the increase of pay which he allowed them in these expeditions, but from the zeal with which he partook of all the duties of a common soldier, being constantly found in the points of danger, and fighting as an individual soldier while he commanded as a general.

Notwithstanding this general popularity of Maximinus, he had lost the affections of his subjects, and many partial but ill-devised conspiracies were formed against him. The plot contrived by Magnus, of abandoning the emperor to the enemy, by breaking down a wooden bridge after he had crossed it, was discovered, and on this ground alone he put to death above 4000 of his troops.

Gordian and his son proclaimed emperor. A. D. 237.

In the African provinces, the spirit of discontent arose to a still higher pitch. Roused by his cruelties and inordinate exactions, they first slew his procurator, and then proclaimed a new emperor. The person on whom this choice fell was Gordian, the proconsul of Africa, who had now reached his 80th year, and whose talents and virtues were well known in the empire. The soldiers and the people literally forced upon him this unexpected honour; and he and his son, who was then forty-six years of age, were declared emperors. Gordian lost no time in acquainting the senate with these events. He assured them of his aversion to such an office, and stated that he would retain his authority no longer than till he had freed the empire of its present oppressor. The senate and the people unanimously confirmed the election of Gordian. They declared Maximinus an enemy and traitor. They displaced his governors, and commanded the provinces to acknowledge Gordian.

No sooner did Maximinus hear of these transactions, than he threw himself into a fury which nothing could control. He is said to have raged like a wild animal, and to have beat his head upon the wall; but when he recovered from this fit of distraction, he harangued his army, promised them the estates of his enemies, and resolved to march to Rome to deal out slaughter and revenge among his enemies. During his progress through the provinces, he learned with joy that Capelianus, the governor of Numidia, had continued faithful to his cause, that he had slain the younger Gordian in battle and destroyed his army, and that the elder Gordian had strangled himself when he heard of the death of his son.

Death of the two Gordians.

These unlooked for events, while they raised the hopes of the tyrant, produced the most terrible consternation in Rome. Without the aid of Gordian, and without time to prepare effectually for their defence, the senate assembled in the temple of Jupiter, and after the most solemn deliberation, they elected Pupienus and Balbinus joint emperors.

Pupienus and Balbinus elected emperors.

Accustomed to the government of provinces, and the command of armies, the new emperors raised levies with the utmost expedition; and Pupienus marched at the head of them to oppose the entrance of Maximinus. No sooner had they left the city, than two of Maximinus's soldiers who had entered the senate-house were slain by two of the senators. The Prætorian troops took offence at this event. Rome became the scene of a bloody tumult, and the city was set on fire by the soldiers.

The news of his having been deposed by the senate, threw Maximinus into the most violent rage. He hurried on his army for the purposes of revenge; but instead of finding repose, food, and supplies, in the fertile vales of Italy, he was obstructed by the strong holds of the country, into which the senate had taken the precaution of carrying every kind of sustenance. Aquileia, which he expected to enter without opposition, was defended by Crispinus and Menophilis, who ordered scalding pitch and sulphur to be thrown down upon the scaling parties, and thus forced them to abandon the assault. Dreading the cruelties of Maximinus, the old men and women were seen fighting on the ramparts; and the women are said to have cut off their hair to furnish the soldiers with bow-strings. The enraged emperor attributed the resistance of the besieged to the incapacity of his own generals, and put many of them to death; and the discontent which this occasioned soon swelled into a mutiny, from the famine and fatigue with which the troops were exhausted. The mutineers were at first afraid to attack a man of such gigantic strength, but having enlisted his own body guards in their cause, they slew both him and his son when they were asleep at noon in their tent; and thus freed the empire from the greatest scourge with which it had yet been afflicted. Maximinus perished in the third year of his usurpation, and in the sixty-fifth year of his age. His body was left to be devoured by dogs and birds of prey.

Rome being thus freed from her alarms before her armies met those of the usurper, Pupienus returned to Rome to enjoy the tranquillity of peace. He was received with the greatest rejoicings, thanksgivings were offered up for the deliverance of the city, and whole hecatombs blazed on the altars. The Persians having begun to make aggressions against the Romans, Pupienus was preparing to march against them with a powerful army, when events of a more serious nature claimed his attention. Although both the emperors were distinguished by their wisdom and experience, yet the fiend of jealousy seems to have early conspired to separate them. Pupienus was universally allowed to surpass his colleague, both as a soldier and a statesman; but as he was the son of a blacksmith, Balbinus considered himself as his superior both from his opulence and from his family. The petty dissensions which from these causes took place between the rival emperors, emboldened the Prætorian guards to effect a change in the government, which they had long contemplated. They therefore attacked the palace when the emperors were returning from the capitoline games. Perceiving the approach of the troops, and anticipating its object, Pupienus sent for the German guards, who were stationed round Balbinus; but whether Balbinus wished to leave his colleague unprotected, or whether he prudently retained the guards for his own defence, he refused to send any assistance to Pupienus. The Prætorian troops meeting with no resistance, seized both the emperors, and dragging them to the camp, they put them to death, and left their bodies in the streets.

While the tumult which was thus excited was at its height, the mutineers met accidentally with Gordian, the grandson of their late emperor, in the street. This amiable young man, then in his sixteenth year, promised, by his virtues and talents, to retrieve the Roman character. The senate and the people concurred with the army in his election. His governor and instructor, Misitheus, who had been celebrated for his eloquence and public virtues, was entrusted with the most responsible offices in the state. The emperor married his daughter, Furia Sabina Tranquillina, and followed the advice of his father-in-law in every question of importance. They reformed the various abuses which had crept into the government; they restored the ancient discipline of the army; they endeavoured to reconcile the soldiers and the citizens, and they laid up stores of provisions in the chief towns of the empire, in order that, upon any emergency, a large army could be maintained for fifteen days.

Having thus established himself in the good opinion of his subjects, Gordian marched into the east to attack Sapor king of Persia, who had seized upon Antioch, and plundered Syria and the adjoining provinces. During his march to the east, he fell in with an army of the Gauls in Mæsia, who had endeavoured to settle in Thrace; and after many successful conflicts, he compelled them to retreat into their own territories. He next advanced against the Persians; and after defeating the army of Sapor, he obtained possession of several of the most flourishing cities in the east. The senate decreed a triumph to Gordian, and selected Misitheus as the guardian of the state. This able and upright minister, however, who had been made Prætorian prefect, and who had a principal share in the success of the Roman arms, died very suddenly, and was supposed to have been poisoned by one Philip, an Arabian, who succeeded him as Prætorian prefect. Misitheus bequeathed all his possessions for the public benefit. The good fortune of Gordian seems to have left him at the death of his father-in-law. The army was not supplied with provisions as before; and Philip artfully took advantage of the discontent which was thus occasioned. He contrived to have himself raised to equal power with Gordian; and having attained this elevation, he assassinated his colleague, who died in the twenty-second year of his age, and the sixth of his reign. The senate honoured the remains of Gordian with a splendid funeral on the confines of Persia; and they decreed that his descendants should be freed from all the heavy taxes of the state.

After having thus assassinated his colleague and his patron, Philip was proclaimed emperor by the army; and their choice was with some reluctance confirmed by the voice of the senate, who gave him the title of Augustus. Philip ascended the throne at the age of forty; and he associated with him, as the partner of his power, his son, who was only six years of age. His father, who was an Arabian, had been captain of a band of robbers, and had no doubt brought up his son to the same adventurous profession. Philip conceived a desire to visit the scenes of his early exploits, and before he set off from Rome, he went into Arabia, and laid the foundation of a city, to which he gave the name of Philippopolis. Leaving Mesopotamia a prey to the Persians, he returned to Rome, where he was received with respect and submission, though not with the usual acclamations of the people. He soon, however, rendered himself popular by his great liberality and profusion. As the thousandth year of Rome fell in the reign of Philip, he caused the secular games to be celebrated with a magnificence corresponding to the joy of this event. The people were entertained with games and shows. The theatre of Pompey was crowded for three days and three nights in succession, and two thousand gladiators bled at once in the circus to administer to the amusement of the people.

The Goths having invaded the empire, Marinus, the lieutenant of Philip, was sent against them with a powerful army. This ambitious general, however, betrayed his trust, and was declared emperor by his troops; but in a short time the very persons who conferred upon him this dignity, took it from him and put him to death. Decius, whom Philip had appointed to succeed Marinus in Pannonia, was now offered the imperial dignity by his soldiers; but he appeared to assume the honour with reluctance, and wrote to Philip that he took the title merely to secure it to its rightful possessor, to whom he waited only for a favourable opportunity of resigning it. Distrusting these professions, Philip marched with the forces which he was able to collect; but when his army had arrived at Verona, a general revolt took place in favour of Decius. A sentinel attacked the emperor in person, and cleft his head in two by one cut of his sword. Philip who had reached the forty-fifth year of his age, and had reigned about five years, was succeeded by Decius.

Murder of Philip.
A. D. 249.

Decius proclaimed emperor.
A. D. 250.

Cneius Metius Decius was universally acknowledged emperor by the senate and the people. The senate held him in such high estimation, that they gave him the title of Trajanus; and in the opinion of historians, he seems to have merited this exalted surname. He permitted the office of censor to be revived; and Valerian, a man of the strictest morals, was elevated to that office. Decius endeavoured to watch over the interests of the inferior classes of the people, while he guarded the dignity of the Patrician orders; but Rome had now arrived at such a state, that no individual talents, and no high example of virtue, could save her from destruction. The rapid spread of the Christian religion, and the constant disputes which were carried on between the Christian and the Pagan inhabitants, created divisions at home, while the growing insolence and audacity of the barbarian hordes of the north, threatened the destruction of the empire from without. The persecution of the Christians, which arose from the first of these causes, was carried on with unrelenting hatred. Thousands were put to death; and every species of cruelty was resorted to in order to reduce their numbers and their influence. An irruption of the Goths into Thrace and Mæsia, seemed to follow as a punishment for this persecution. Decius went at the head of a powerful army to oppose them; and, after an obstinate engagement, he succeeded in destroying 30,000 of the barbarians. In following up his success, he was led into a defile by the treason of his own general, Gallus, where the king of the Goths had been instructed to assail him. In this position of danger, the brave emperor, after seeing his son fall by an arrow, and the whole of his army routed, resolved to die on the field of battle which he had lost. Spurring on his horse, he plunged into a marsh, where he was instantly swallowed up, and his body never more seen. This event happened in the fiftieth year of his age and the third of his reign.

Persecution of the Christians.
A. D. 50.

Irruption of the Goths, who are defeated by Decius.

Decius betrayed by Gallus, and destroys himself.
A. D. 251.

The remnant of the Roman army which had survived this disgraceful battle, proclaimed Gallus Hostilius the successor of Decius. Though descended from an honourable family, he seems to have been as destitute of

Gallus proclaimed emperor. A.D. 251.

military courage as he was of private honour. Instead of arraying the strength of Rome against the invaders, he purchased peace by an ignominious tribute to the Goths, and returned to the capital to devote himself to indolence and licentiousness. The Goths, however, whose friendship he had bought, soon forgot their bargain, and rushed in upon the eastern provinces. The Persians and Scythians were encouraged by their example, and spread their desolating armies over Syria and Mesopotamia. While the distant members of the empire were thus wasted and plundered, disorders equally fatal were raging at its heart. The Christians were persecuted with new malignity; a frightful pestilence, which seems to have been widely extended, scourged the empire for several years; and a civil war now added its horrors to these already existing evils.

Gallus and his son killed in an engagement with Æmilianus. A. D. 253.

After conquering the Goths, Æmilianus, the Roman general, was proclaimed emperor by his troops. Gallus marched into the east to oppose him; and in a battle which took place in Mœsia, Gallus, and along with him his son Volusian, was slain in the 47th year of his age, and the third of his reign.

Æmilianus now expected to be acknowledged emperor by the senate; but they refused to confer upon him this honour, and, when their refusal was made known, the army stationed in Rhætia proclaimed their general, Valerian, emperor. The prospect of a civil war between these two competitors, induced the army of Æmilianus to put their own commander to death, and to concur in the general attachment to Valerian.

Æmilianus slain by his own army. A. D. 253.

Valerian proclaimed emperor. A. D. 253.

Publius Licinius Valerian was raised to the empire at the age of 78, and united the suffrages of all classes of the Roman people. That moderation, however, and those virtues which had distinguished him in private life, did not display themselves to great advantage when he came to the supreme power. He wanted courage in his military operations, and, though he affected to be the patron of science, yet he does not seem to have bestowed any essential favours on men of true genius or merit. Valerian, however, made many good attempts to reform the abuses of government; but he left a blot upon the character of his reign, by his malevolent persecution of the harmless Christians. The incursions of the northern hordes called Valerian into the field against the Goths and Scythians; but the invasion of Syria by Sapor, king of Persia, compelled him to undertake an expedition for its relief. His arms, however, were unsuccessful in Mesopotamia; and when he wished to have a private conference with Sapor, he was treacherously taken prisoner, and carried in triumph to the capital. Here he exposed him in public to the insults of the people. He loaded him with ridicule and indignities of every kind, and he used the captive monarch as a footstool whenever he mounted on horseback. After a captivity of seven years, Sapor at last put out his eyes, and ordered him to be flayed alive, and salt to be thrown over his mangled body, till he perished in the greatest torment. His skin is said to have been afterwards tanned and painted red, and nailed up in one of the temples of Persia as a warning to the future emperors of Rome.

Valerian taken prisoner by Sapor. A. D. 260.

Cruel death of Valerian.

General invasion of Rome by the barbarians.

The success of the Persian arms inspired all the northern nations with the hopes of subjugating Rome. While the Goths and Scythians ravaged Pontus and Asia, the Franks and Alemanni carried fire and sword into Rhætia, and advanced as far as Ravenna. The Sarmatians and the Quadi about the same time entered Dacia and Pannonia; and other barbarous tribes invaded Spain, and took possession of many of their strongholds.

In this crisis Gallienus, the son of Valerian, animated with a passion for revenging the sufferings of his father, and punishing the insolence of the barbarians, was chosen emperor by universal consent. Hastening from Gaul into Italy he drove out the barbarians, and delivered Rome from the terrors of an invasion. Regillianus, who commanded in Dacia and Pannonia, was equally successful, and even beat them in several engagements in one day.

A general of the name of Ingenuus, who commanded in Pannonia, was proclaimed emperor by his troops; but Gallienus lost no time in marching against him, and having come up with him in Illyricum, he defeated his army, and Ingenuus was either slain by his troops after the battle, or took away his own life to avoid the enmity of Gallienus. The cruelties which the emperor exercised after this battle were of the most intolerable kind; he ordered all males, whether old or young, to be destroyed; he slew all who had either spoken ill of him, or had wished him ill; and he commanded one of his officers, Verianis Celis, in a letter which still exists, to tear, kill, and cut in pieces without mercy. In consequence of these cruelties, the soldiers who had served under Ingenuus, and the inhabitants of Mœsia, proclaimed Q. Nonius Regillianus emperor.

This general, who was born in Dacia, is said to have been a descendant of king Decabalus, who was conquered by Trajan. He had acquired great reputation as a soldier, and had defeated the Sarmatians in several battles after he was proclaimed emperor. He did not, however, possess long the imperial honours; having been killed by his own troops in the year of our Lord 262.

The facility of being now made an emperor, and the short period during which that honour was held, brought forward a number of generals who were proclaimed by their respective armies. These candidates for the imperial purple were nineteen, and they have received the name of the thirty tyrants. The following is a list of them: Regillianus, Ingenuus, Cyriades, Macrinus, Balista, Udenatus, Zenobia queen of Palmyra, Posthumius, Lollianus, Victorinus, and his mother Victoria, Marius and Tetricus, Aureolus, Saturninus, Trebellianus, Piso, Valens, Æmilianus, and Celsus.

Though the name of tyrants has been applied to these aspiring individuals, yet their ambition was in general called forth by the infamous cruelties of Gallienus, and many of them were men pre-eminent by their virtues as well as by their talents, who had been compelled by their soldiers to receive the empty title. The enemies of the emperor being thus divided, none of his rivals had strength enough to resist the arms of Gallienus, who still maintained the diadem, while all his nineteen opponents suffered by some violent death.

The defenders of the state being thus occupied with their own objects of ambition, the common enemies of Rome were permitted to ravage the empire on all sides; and the ablest and most patriotic of the Roman generals being thus left without support, and obliged to introduce barbarians into the service, were compelled to enter into the most dishonourable treaties with their invaders.

An unlooked for event, however, restored for a while the drooping spirits of Rome. While Gallienus was besieging one of his rivals, Aureolus, in Milan, he was murdered by Martian, one of his own generals, and Flavius Claudius was nominated his successor,—an appointment which was gladly confirmed both by the senate and the people.

Flavius Claudius, supposed by some to be a Dalmatian, by others to be a Trojan, and by some a son of the emperor Gordian. In the 55th year of his age, he had to retrieve the almost desperate affairs of the empire. Strong in body, vigorous in intellect, temperate in all his desires, an admirer of virtue, and a severe dispenser of punishment, this great man seemed destined to reform the degeneracy of the age, as well as to recall the ancient glories of the Roman name. After defeating Aureolus near Milan, he conducted a numerous army against the Heruli, the Trutangi, and the Virturgi, who had descended the Danube in 2000 ships, and being well supplied with ammunition and provisions, spread an universal alarm through all the adjacent provinces. The Goths had already desolated Greece, and pillaged Athens; and the cruelties and devastations which they there committed, inspired the Romans with fresh alarm. Claudius, however, marched against them with an army every way disproportionate to them, and he either cut to pieces, or took prisoners, the whole of their vast army, which amounted to above 300,000. Every province was supplied with slaves from the captives, and every house was filled with the arms which were taken. His success inspired courage into the Roman soldiers, and the Goths were defeated in all the frontiers of the empire. After subduing the revolted Germans, Claudius carried his arms against Tetricus and Zenobia, two of the nineteen sovereigns who still exercised a sort of imperial authority in the east. He was seized, however, with a pestilential fever near Sirmium, in Pannonia, where he died in a few days, after a virtuous and glorious reign of nearly two years. The historians of Rome represent Claudius as uniting the piety of Antoninus with the valour of Trajan and the moderation of Augustus; and this exalted character is remarkably confirmed by the words which the senate addressed to him when alive, *Claudi Auguste, tu frater, tu pater, tu amicus, tu bonus senator, tu vere princeps.*

Quintillus, the brother of Claudius was for some time acknowledged as emperor, more from respect to his brother's memory than from any splendid accomplishments of his own; but the military position of Rome demanded an experienced and brave commander, and on this account, the army with one accord elected to the empire Aurelian, who was general of the horse, and who had been recommended by Claudius himself. When Quintillus heard that Aurelian was marching against him, he opened his veins in a bath, and thus died after a reign of seventeen days. After a vigorous reign of nearly five years Aurelian was murdered by Mnestheus, in the beginning of the year 275. A minute account of the events of his reign have already been given under our article AURELIAN, Vol. II. p. 109.

The miserable fate of the thirty tyrants seems to have operated as a check against that imperial ambition which seems to have been inherent in almost every Roman general. No individual ventured to declare himself a candidate; and the army itself, as if tired of the exertion of its patronage, modestly referred the appointment to the senate. The senate declined to exercise the right thus assigned to them, till Rome had been left for eight months without a political or a military ruler. They at last elected M. Claudius Tacitus in the 70th, or as some say the 75th year of his age; but the good old man refused the honour, and retired to his country house in Campania to avoid the urgency with which it was pressed upon him. The necessities of the state, however, induced him to yield to the importunities of the senate. He began his reign by punishing those who had been concerned in the murder of his predecessors. Mnestheus was impaled alive, his body devoured by wild beasts, and his estate applied to public purposes. The senate recovered their privileges, and seem not only to have been the counsellors of the emperor, but to have exercised a control over his measures. When the emperor was desirous of having his brother-in-law raised to the consulship, the senate refused his request, and the emperor calmly replied, that the senate was better able to judge than himself of the fitness of the candidates. Tacitus was a pattern of temperance, economy, moderation, and impartiality. He paid great attention to the morals of the people; and he not only abolished the brothels which had so long corrupted the city, but he ordered all the public baths to be shut at sunset, and thus contributed greatly to the morality of the capital. Tacitus was also addicted to literature and to the patronage of distinguished men. He boasted of being a descendant of his namesake the great historian; he ordered his works to be placed in all the public libraries; and he commanded ten copies of them to be written every year with great care and accuracy, in order that so valuable a work should not be destroyed by accident or design.

Tacitus elected emperor. A. D. 275.

To these peaceful virtues Tacitus added the accomplishments of a warrior. He drove back the barbarians who had made an irruption into the Roman provinces in Asia; and when he was making preparations for an expedition against the Persians and Scythians, he died of a violent distemper in Cilicia, and according to others, he was assassinated after a reign of six months, and in the year 276.

Death of Tacitus. A. D. 275.

The place of Tacitus was not easily supplied, and the army were divided in the choice of an emperor. All parties agreed in the necessity of having a brave, a moderate, and a good man; and though Florianus, the brother-in-law of Tacitus was elected by one part of the army, yet the decision in favour of Probus was unanimous, and Florianus finding himself deserted by his own friends, opened his arteries and bled himself to death.

Probus elected emperor. A. D. 276.

Marcus Aurelius Severus Probus was the son of a gardner at Sirmium in Pannonia; but his father having entered the army obtained the rank of a military tribune. Probus rose to the same rank in the twenty-second year of his age; and was so highly distinguished by his clemency, valour, and probity, that he was raised to the empire in the forty-fourth year of his age. In his early life, he was frequently the first of the besiegers who scaled the walls of the enemy, and who broke into their camp. He had also come off victorious in many single combats, and had saved the lives of several distinguished citizens. When he had arranged the affairs of government, he marched with a numerous army to repress the incursions of the Gauls, and after several obstinate conflicts, he left no fewer than 400,000 dead on the field. He next turned his arms against the Sarmatians, who had invaded Dalmatia, and after obtaining the same success in that quarter, he conducted his troops into Thrace, and compelled the Goths to sue for peace. He next marched into Asia, and having subjugated Isauria, &c. he defeated with great slaughter a numerous army of the Blemmyes, a savage tribe, who had left the wilds of Ethiopia, and retained possession of Arabia and Judea since the time of Gallienus.

The military renown of Probus being thus made known to his enemies, the king of Persia sued for peace, and endeavoured by the most splendid presents to purchase the favour of the emperor. When the ambassadors were introduced with their offers, Probus was refreshing himself with the most common fare, and without deigning to cast his eyes upon them, he said, that if the Persian king did not make proper satisfaction to the Romans, he would leave their territories as naked as the crown of his head. Upon saying this, he took off his hat, and exhibited the crown of his head to the ambassadors. The Persian monarch accepted of the proffered conditions, and Probus returned to Rome, and was honoured with a triumph which lasted several days.

Having vanquished his foreign enemies, Probus was next employed in pulling down various usurpers of his power. Saturninus, whom the Egyptians had forced to declare himself emperor, was defeated and killed. Proculus, another pretender to the empire, who was notorious for his debaucheries, and who had acquired wealth by his piracies, was defeated; and having been delivered up by the Germans, was exposed on a gibbet. Bonosius, celebrated as a drunkard, next raised the standard of rebellion; but having been beaten, he hanged himself in despair.

When the Goths and Vandals saw the extent of these domestic commotions, they resumed their inroads into the empire; but Probus succeeded in driving them among their native wilds, and returned in triumph to Rome. Probus now devoted himself to the arts of peace. He encouraged the inhabitants of Gaul and Illyricum to plant vines in their territories, and he repaired no fewer than seventy cities which had fallen into decay in different parts of the empire.

Probus murdered by his soldiers. A. D. 282.

Having passed through his native city of Sirmium, on an expedition against the Persians, he employed several thousands of his soldiers in draining a fen in its neighbourhood by means of artificial canals communicating with the sea. The troops, however, disliking the labour of this task, mutinied and attacked Probus as he was passing into one of the towns of Illyricum. The emperor escaped into an iron tower, which he had built for the purpose of watching the operations in the marshes; but having none of his guards along with him, he was overpowered and murdered in the 50th year of his age, and the seventh of his reign. The news of this event occasioned great consternation in Rome. Both his friends and his enemies deplored his loss; and the very army who had basely murdered him erected a monument over his body, with the inscription, *Hic Probus imperator, vere Probus, situs est, victor omnium gentium barbarorum, victor etiam tyrannorum.*

Carus succeeds to the empire.

Probus was succeeded by Aurelius Carus the Prætorian prefect, who was proclaimed by the army, who appointed his two sons Carinus and Numerianus to assist him in his duties. He was employed in bringing to punishment the murderers of Probus, he was called upon to repel an attack from the Sarmatians, and also from the Persians. After defeating the former in a decisive battle, he conducted his army into Persia, and marching to the very walls of Ctesiphon, he overthrew the Persian army with great loss. He did not live, however, to enjoy this success, for he and many of his attendants were killed by a stroke of lightning in his tent. The distress of his youngest son Numerianus, is said to have been so great that he brought on a severe disease in his eyes by excessive weeping, and was obliged to accompany the army shut up in a close litter. Aper, his father-in-law, conceived the design of aiming at the sovereignty. He hired an assassin to murder Numerianus in his litter; and in order to conceal the deed, he announced, that Numerianus was unable to bear the light, and the deception was kept up till the smell of the dead body discovered the treachery of Aper. An uproar was immediately excited in the army. Dioclesian was chosen emperor, and with his own hand slew Aper. Carinus, however, the other brother, still resisted the election of Dioclesian, and the rival armies having met in Dalmatia, Dioclesian was victorious, and Carinus was slain by a tribune of his own army, whose wife he had debauched.

When Dioclesian ascended the throne he assumed his general Maximian as his partner in the empire, and after a reign of twenty-one years, the events of which we have already fully detailed in our life of DIOCLESIAN, (Vol. VII. p. 746.) they resigned.

Constantius Chlorus and Galerius, who had been created Cæsars by Dioclesian and Maximian, were now proclaimed their successors. The former was distinguished by his bravery, his humanity, and his virtues; while the latter debased his personal courage by his cruelty and incontinence. Having agreed to divide the empire, Constantius received Italy, Sicily, the greater part of Africa, along with Spain, Great Britain, and Germany; while Galerius obtained the dominion of Illyricum, Pannonia, Macedonia, the provinces of Greece, Asia Minor, Egypt, Syria, Judea, and other eastern countries.

In order to enable them to look after such extensive territories, they assumed two partners, Severus and Maximian, so that the Roman empire was now governed by four individuals possessed of supreme power. The conduct of Constantius did not disappoint the expectations of his friends. He treated the Christians with peculiar humanity; and when he had been persuaded to displace those officers of his household who would not renounce the Christian faith, he sent away in disgrace those who were disposed to renounce it, and declared that they could never be faithful to their prince who were not steady to their God.

When Constantius went over into Britain, he took up his residence at York; but being there taken ill, he sent for his son Constantine with the view of appointing him his successor. Constantine arrived when all hopes of his father's recovery were at an end, but the dying emperor was still able to give many useful instructions to his son, and to recommend the Christians to his special protection. After bequeathing to him the empire, he expired in the arms of his son.

When Galerius was informed of the death of his colleague, and of the advancement of Constantine, he could scarcely restrain himself from some act of violence; but he was at last induced to send the ensigns of royalty to Constantine, though he at the same time declared Severus to be the successor of Constantine. In this emergency Maxentius, a favourite of the king, but a person of low origin, usurped the imperial power. Severus conducted a numerous army against the usurper, but they abandoned him as soon as they reached the gates of Rome, and mortified at their defection, he put an end to his existence by bleeding himself to death. Intent upon revenge, Galerius marched into Italy, and appointed Licinius in the room of Severus; but he was soon seized with an extraordinary disease, which cut him off after suffering great agonies; and which the Christians ascribed to the cruelties which he had exercised against them.

The empire was now in the possession of four claimants, of Maxentius, who commanded in Rome, of Licinius, who governed in the East, of Maximus, who had been declared Cæsar along with Severus, and who also ruled some of the eastern provinces, and of Constantine, who succeeded to his father.

When Constantine was conducting his army to Rome, to oppose the tyranny of Maxentius, he saw the celebrated vision of the cross which converted him to Christianity, and of which we have given an account in our life of CONSTANTINE, vol. VI. p. 179. After defeating and killing Maxentius, Maximus, and Licinus, Constantine restored tranquillity to the empire, established Christianity as the national religion, and transferred the seat of government from Rome to Constantinople.*

After the death of Constantine, the Roman empire was divided, at his desire, among his three sons, Constantine, Constans, and Constantius. To the eldest, Constantine, he gave Gaul, Spain, and Britain; to the second, Constantius, Asia, Syria, and Egypt; and to the youngest, Constans, Illyricum, Italy, and Africa. To his nephew, Dalmatius, Constantine had bequeathed Thrace, Macedon, and Achaia; and to his other nephew, king Annibalianus, Armenia Minor, Pontus, Cappadocia, and the city of Cæsarea. The senate and army, however, proclaimed the three sons of Constantine emperors, without paying any attention to his two nephews, who, along with Julius Constantius, Constantine's brother, and all their friends and adherents, were soon after murdered. Gallus and Julian, two of the sons of Julius Constantius, were alone saved; the former from his being afflicted with a severe malady, and the other on account of his infancy.

Not contented with his own dominions, Constantine invaded the dominions of Constans, and made himself master of several towns in Italy. Constans marched his army into the field, and Constantine, having fallen into an ambuscade near Aquileia, was cut off with his whole army. His body was thrown into the river Ansa, but was afterwards interred near his father's grave in Constantinople.

For a period of ten years Constans retained the undisturbed possession of the western empire; but his ndolence having brought him into contempt with his army, Magnentius, a German, revolted against him, and having seized upon the imperial palace at Actium, he acquired some temporary popularity by distributing mong the populace the plunder of the palace. Contans fled into Spain, but being pursued by Gaiso with body of troops, he was slain near Helena, a small village at the foot of the Pyrenees.

Having subdued the Persians, Constantius now turned his arms against the usurpers of his power; mong whom were Veteranio, a general of infantry in Romania, and Nepotianus the son of Eutropia, the sister of Constantine the Great. Nepotianus made imself master of Rome, and committed great slaughter mong the inhabitants; but Marcellinus, the prime minister of Magnentius, marched against him, and after bloody battle, defeated and slew Nepotianus. Marcellinus and Magnentius committed great cruelties on the inhabitants; and by means of the heavy exactions which they made upon the rich, they were enabled to assemble a powerful army, composed of the various nations that were subjugated by Rome. Before, however, trying the chances of war, Magnentius, along with the other usurper Veteranio, proposed terms of peace to the emperor. Constantius was induced to make a separate treaty with Veteranio, and to assume him as a partner in the empire; but when Veteranio ascended the tribunal along with Constantius, the soldiers pulled him down, and refused to acknowledge any other emperor than Constantius.

After raising his cousin Gallus to the rank of Cæsar, Constantius excited the Franks to invade Gaul; but Magnentius marched into Pannonia to meet him, and having challenged him to fight on the plains of Sciscia, upon the Save, Constantius's army fell into an ambuscade, and were routed with great slaughter. Elated with this success, Magnentius haughtily rejected offers of peace made to him by Constantius, and a general engagement having been brought on at Mursa, Magnentius was defeated with the loss of 24,000 men.

A. D. 352.

After various other successes, in which Constantius took Aquileia,—Africa, Italy, and Spain declared for Constantius; and Magnentius, perceiving the desperate condition of his affairs, dispatched an assassin to murder Gallus Cæsar, in the hopes of compelling the emperor to withdraw his forces from Gaul. The assassin, however, was seized and executed, and Magnentius, having experienced a severe reverse in Gaul, took refuge in Lyons, where he slew himself and all his relations who accompanied him, from the dread of being delivered up by his soldiers to the emperor. His brother, Decentius, whom he had made his partner in power, also strangled himself, and Constantius remained the sole possessor of the empire.

Magnentius kills himself.
A. D. 353.

The general tranquillity, however, was soon disturbed by the irruptions of the barbarians into many of the provinces; but especially by the tyrannical conduct and cruelties of Gallus, who, at the instigation of his wife Constantine, filled the provinces with blood. As soon as Constantius heard of his exactions and his cruelties, he sent for him to Italy; but having made a fruitless attempt to revolt, he confessed his crime, and was put to death by the order of the emperor.

Gallus put to death.
A. D. 354.

After quelling an insurrection in Germany, and putting to death Sylvanus, a leader of the Franks who had revolted, Constantius was called upon to defend Gaul against the inroads of the barbarians. Deeming it imprudent to leave Italy, he raised his cousin Julian to the dignity of Cæsar; and though this young man had devoted himself principally to literature, he yet exhibited the greatest bravery and skill in the field. Constantius appointed him governor of Gaul, and gave him his sister Helena in marriage. He therefore set out for Gaul, and having come up with the barbarians in the thick woods between Auxerre and Troyes, he defeated them with great slaughter. Having next defeated the Germans, he advanced to Cologne, and after repairing its fortifications, he took up his winter quarters at Sens. Here he was besieged by the barbarians for nearly a month, and having at last forced them to retire, he was appointed by Constantius commander in chief of all the forces in Gaul. After defeating the Leti with great slaughter, and forcing the barbarians to quit the islands of the Rhine, he came up with their main army, commanded by Chnodomarius and six other kings, who had encamped in the neighbourhood.

A. D. 357.

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* See CONSTANTINE, Vol. VI. p. 179, for a full account of his reign.

of Strasburg, and having given them battle he defeated them with immense loss, and sent Chnodomarius a prisoner to Rome. Julian next entered Germany, and concluded a truce with the barbarians, which was afterwards converted into a peace favourable to Rome.

A. D. 359.

After a successful expedition against the German tribes, Constantius declared war upon Sapor, king of Persia, and marched against him in person; but having requested a portion of Julian's troops to assist him, the soldiers refused to quit their favourite general, and went so far as to proclaim him emperor. Julian seems to have had no farther ambition than to share the sovereignty with his cousin; but Constantius refused to divide his power; and, as he was marching against his rival, he was seized with a fever at Mosucrene, at the foot of Mount Taurus, which cut him off in the 45th year of his age.

Death of Constantius.
A. D. 361.

Important laws enacted by Constantius.

The reign of Constantius has been rendered remarkable in history, by the peculiarity of some of the laws which he enacted. In the year 356, he made it a capital crime to offer sacrifices, or to pay any sort of worship to idols. In 357, he enacted that the effects of every Christian who renounced his religion for Judaism, should be confiscated; and he removed every kind of impost from such of the travelling merchants as were ecclesiastics. In 358, he declared all magicians, augurs, astrologers, and pretenders to divination, enemies to mankind; and in 359, he established a court of inquisition against all who consulted heathen oracles. But this tribunal was characterised by the same barbarities which disgraced a similar establishment in succeeding ages.

Julian succeeds to the empire.
A. D. 361.

Julian, who has since been known by the name of the Apostate, restored the pagan religion, and, after a short reign of twenty months, of which we have given a full account in the article JULIAN, Vol. XII. p. 390, he died of a wound received in a skirmish against the Persians, in the 32d year of his age.

A. D. 363.

Jovian raised to the empire.

Upon the death of Julian, the army unanimously raised to the empire an able general, Flavius Claudius Jovian, a native of Pannonia. Having been educated in the Christian faith, he at first refused the imperial diadem, on the ground that the people whom he was to govern had relapsed into the idolatry of their ancestors; but when the army assured him that they preferred the Christian religion, he immediately accepted of the sovereignty. Upon the death of Julian, the troops which he had conducted against the Persians had been left in extreme distress; a famine raged in the camp to such a degree, that every man would have perished had not the Persians made them offers of peace, and, though the terms were in general disadvantageous, in so far as they involved a surrender of territory to the Persians, yet, considering the state of the Roman army, they could not be too highly appreciated. Being now permitted to return homewards without molestation, Jovian had no sooner arrived at Antioch than he revoked all the laws that Julian had enacted against the Christians, and in favour of the pagans. He took part with the orthodox Christians against the Arians, and having recalled Athanasius, in a letter written in his own hand, he is said to have requested him to compose the celebrated creed, which is now known in every corner of the Christian world. These enactments, made during the march of his army, are an earnest of what might have been expected from Jovian, had he been permitted to reign; but on his way to Constantinople he was found dead in his bed, having been suffocated by the vapours of charcoal which had been lighted in his room.

Death of Jovian.
A. D. 364.

On the death of Jovian, Valentinian was proclaimed emperor; and the soldiers having insisted that he should assume a partner in the empire, he chose his brother Valens.

The empire having been invaded on all sides, it was thought necessary to divide it between the two sovereigns. In this partition, which was made at Mediana, in Dacia, Valentinian received Illyricum, Italy, Gaul, Spain, Britain, and Africa; while Valens obtained Asia, Egypt, and Thrace. Valentinian displayed his military skill in the successes which he obtained over the barbarians both in Africa and Gaul, and on the banks of the Rhine and the Danube. The Quadi having revolted, he took the field against them, and laid waste their country with fire and sword. The Quadi then sent ambassadors to sue for peace; but the emperor upbraided them for their conduct, and while in the act of speaking in great warmth, he burst a blood-vessel, and fell upon the ground. When conveyed to his chamber he was seized with violent convulsions, and expired in the greatest agony in the 55th year of his age, and the 12th of his reign.

The reign of Valens in the east was disturbed by the revolt of Procopius, who was aided by Eugenius, a wealthy eunuch, whom Valens had disgraced. The emperor was disposed to abdicate the sovereignty; but his friends would not permit him. Procopius, on the other hand, became odious to his own friends, who speedily abandoned him; and, in a battle which took place between him and Valens, he was taken prisoner, and put to death.

The Goths, who were marching to the assistance of Procopius, retired when they learned his misfortunes; but Valens took them all prisoners; and in the war with those barbarians which succeeded, Valens was successful, and compelled them to make a peace advantageous to the Romans. The reign of Valens has been distinguished by his persecution of the orthodox clergy. Eighty of these clergy were sent to the emperor to complain of the treatment they had received; but he summarily ordered them to be put to death. The person, however, who was charged with this odious duty, dreading a popular commotion, put them all on board a ship, and, when it was at some distance from the shore, the sailors set it on fire, and escaped in their boats. Valens likewise persecuted magicians, and all those who had books of magic in their library. Death and confiscation were the punishment which he inflicted on this occasion, and hence people of all ranks burnt their libraries, lest their enemies might have secretly introduced such works among the rest.

The Goths, after committing great ravages in Macedon and Thessaly, advanced towards Constantinople, and fought a bloody battle, in which they gained considerable advantages. Hurried away by the darkness of the night, and the affection of his soldiers, the emperor took refuge in a country house, which was set fire to by the Goths. Valens, unable to make his escape, was burnt alive in the 50th year of his age, and the 16th year of his reign.

Gratian, the son of Valentinian, who had held the western empire since his father's death, was now left in the sole possession of the sovereignty. After driving back several of the barbarians, Gratian assumed Theodosius his partner in the empire, and assigned to him the provinces which Valens had governed. By his skill and experience in war, he obtained many splendid victories over the barbarians. He defeated the Goths in Thrace, and took 4000 of their chariots, with an immense number of prisoners of both sexes; and such was the effect of this successful campaign, that many of the enemies of Rome sued for peace, and Athanaric, the most powerful of the Gothic princes, courted the friendship of the emperor. This prince died in the same year; and Theodosius caused him to be buried with such splendour and pomp, that the Goths not only resolved never more to molest the Romans; but out of gratitude to Theodosius, they even guarded the banks of the Danube, to prevent any invasion of the empire from that quarter.

In consequence of the enmity of Gratian to the pagan superstition, Maximinus, who undertook the defence of the pagan religion, revolted against the emperor; and having been joined by a number of discontented Romans, they came up with Gratian near Paris. In the battle which ensued, Gratian was deserted by his troops, and murdered by the insurgents in the twenty-fourth year of his age.

As Maximinus announced to Theodosius that he had no design against the dominions of Valentinian, Theodosius acknowledged him as his partner in the empire. Maximinus, however, passed the Alps, and marched to Milan, the residence of Valentinian. This young prince fled for refuge to Theodosius, who promised to assist him on the condition of his renouncing the Arian heresy. In the mean time, Maximinus had made such progress, that he was acknowledged in Rome and in the African provinces; but Theodosius having raised a powerful army of Goths, Alans and Huns defeated Maximinus in two battles; and having taken him prisoner, put him to death. His son Victor was soon afterwards taken prisoner by Arbogastes, and put to death.

Theodosius performed a journey to Rome in 389, and is said to have converted the senate and people to Christianity. In consequence of an attack made upon the Christians by the pagans of Alexandria, Theodosius ordered all the temples in that city to be pulled down, and authorised Theophilus the bishop to see his orders put in execution. The celebrated temple of Serapis was thus razed to its very foundation. The zeal of Theophilus was not contented with this single sacrifice. He excited the people to demolish all the other temples, chapels, and places of worship used by the heathens; and he either burned or melted down the statues of the gods, leaving only the statue of an ape, for the purpose of throwing ridicule upon the pagan idolatry. When Theodosius returned to Constantinople, he ordered all the remaining temples to be destroyed, and the Arians to be expelled from all the cities of his empire.

Valentinian, the emperor of the west, having placed too much confidence in his general Arbogastes, a native of Gaul, was treacherously strangled by that barbarian at Vienne in France, in the ninth year of his reign. Valentinian was a man of real merit and exemplary virtue. He abolished the greater number of the taxes: he was distinguished by his benevolence; and he exhibited his clemency and kindness even to those who had conspired against his life.

Although Arbogastes might have seized upon the sovereignty, yet he conferred it upon one Eugenius, and reigned in his name. Eugenius, though a Christian, was friendly to the pagans. He sent deputies to Theodosius; but he declined entering into any alliance with the usurper, and made immediate preparations to oppose him. With this view he left Constantinople; but found, on his arrival at the Alps, that the passes were guarded by Flavianus with a large body of Roman troops. Theodosius having defeated them with great loss, and taken their camp, Eugenius was made prisoner. His own soldiers, who had brought him to Theodosius, cut off his head while he was begging for his life. The rest of Eugenius's army, when they saw the head of their general upon the point of a spear, and learned that Theodosius was willing to receive them into favour, laid down their arms and submitted. Arbogastes fled into the mountains and put an end to himself; and his children, along with those of Eugenius, took refuge in churches. The emperor, however, forgave them in the true spirit of his religion; and while he converted them to the Christian faith, he restored to them their paternal estates, and raised them to honourable situations in the government. Theodosius appointed his son Honorius emperor of the west; but as he was preparing to return to Constantinople, he was attacked with a dropsy, which carried him off at Milan, in the sixteenth year of his reign, and sixtieth of his age. In the will which Theodosius left behind him, he confirmed Honorius as the emperor of the west, and left the eastern empire to his other eldest son Arcadius.

Death of Theodosius. A. D. 395.

Invasion of the Goths under Alaric. A. D. 397.

No sooner were the barbarians informed of the death of Theodosius, than a formidable army of the Goths, under Alaric their king, ravaged the western territory. They were at last opposed by Stilicho, the general of Honorius, who defeated them with great loss.

Having concluded a treaty with the ministers at Constantinople, Alaric invaded Italy. After some partial advantages, Stilicho attacked them at Pollentia, and completely defeated them in a decisive engagement which lasted the whole day. Having forced their entrenchments with great slaughter, the camp of Alaric was taken; his wife was made prisoner, and all the plunder which the Gothic general had amassed in Greece, fell into the hands of the conquerors; while many of the Roman soldiers were released from captivity. Alaric, however, had still a considerable force, and Stilicho thought it prudent to conclude a treaty with him, and allow him a pension. The Gothic king, however, forgot his part of the contract, and attempted to take Verona on his return. Stilicho was therefore obliged to attack him again; and after a terrible defeat, he drove him out of Italy.

In consequence of these successes, Honorius entered Rome in triumph, with Stilicho seated beside him in the triumphal chariot; and on his entrance, he abolished the inhuman shows of the gladiators, which had continued to disgrace the Christianity of Rome.

This triumph, however, was only of temporary duration. The barbarians now began to inundate the empire at all points. The Vandals, the Saxons, and the Burgundians, united into a mighty host, formed the army of Radagaisus, who has been styled the king of the Goths. About 12,000 warriors, distinguished by their birth and their valour, formed the van of this army, and were followed by about 200,000 soldiers; and if we reckon the women, children, and slaves who accompanied them, the multitude was not less than 400,000 persons.

Radagaisus marches into Italy with a large army.

The emperor of the west looked quietly on at this impending storm; but fortunately, Rome still possessed a general fitted to encounter this alarming host. Despairing of being able to restore the fortifications of the Danube, Stilicho abandoned the provinces, and determined to concentrate all his strength for the defence of Italy. He endeavoured to recruit his armies by every means which could be suggested; but notwithstanding all his exertions, he was unable to collect a greater number than form 30,000 to 40,000 troops. He was largely reinforced, however, by the Alani, the Huns, and the Goths, who marched under the banners of their native princes to check the career of Radagaisus. This mighty leader crossed without resistance, the Alps, the Po, and the Appenines; leaving on one side, Honorius entrenched among the marshes of Ravenna; and on the other, the army of Stilicho encamped at Ticinum or Pavia. After pillaging many of the Italian cities, Radagaisus laid siege to Florence, which for a long time opposed a valiant resistance to his arms. Though reduced to the last extremity, St. Ambrose sustained their sinking spirits, and promised them a speedy deliverance on the authority of a dream. No sooner was this communication made to them than the banners of Stilicho were seen flying in the distance; and they therefore resolved to endure still greater privations. Stilicho deemed it imprudent to expose his army to the risk of a general battle; and adopted the wiser plan of surrounding the enemy with strong lines of circumvallations. A supply of men and provisions was introduced into Florence; and the army of Radagaisus, hemmed in on all sides, began to experience in their turn that famine and distress from which the Florentines had been relieved.

The despair of the starving barbarians forced them into many bloody conflicts with the Roman troops, and after the loss of many of his bravest men, both by famine and the sword, Radagaisus was obliged to capitulate to his enemies. This brave general was ignominiously beheaded, and such of his troops as were taken prisoners were sold for slaves. In consequence of this great success, Stilicho has received the honourable appellation of the deliverer of Italy.

Defeat and death of Radagaisus. A. D. 406.

Gaul seized by the remnant of Radagaisus's army.

The remnant of the army of Radagaisus, which still amounted to 100,000 men, marched into Gaul, the provinces of which had been left entirely defenceless. On the last day of the year, when the Rhine was probably frozen, they entered Gaul without opposition. The flourishing city of Mentz was destroyed, and thousands of Christians massacred in the churches. Worms fell after a bloody siege, and Strasburg, Spires, Rheims, Tournay, Arras and Amiens suffered a similar fate. "The consuming flame of war," says Gibbon, "spread from the banks of the Rhine over the greatest part of the seventeen provinces of Gaul. That rich and extensive country, as far as the ocean, the Alps, and the Pyrenees, was delivered to the barbarians, who drove before them in a promiscuous crowd, the bishop, the senator, and the virgin, laden with the spoils of their houses and altars."

While Gaul was thus passing into the permanent possession of the barbarians, a common soldier of the name of Constantine was made emperor in Britain, in which he governed with much talent and prudence. Honorius, unable to put down the usurpation, acknowledged Constantine as his partner in the empire. In the mean time, Alaric threatened Rome with a new invasion unless he was paid a large sum of money. Stilicho insisted upon complying with that exaction, but the people were so enraged with his acquiescence, and the emperor was so strongly persuaded that he had been intriguing with his enemies, that he ordered him to be beheaded, and thus involved his whole family in ruin. The death of Stilicho seems only to have increased the demands of Alaric. When his demand was not granted, he laid siege to Rome, and would have soon obtained possession of it had not the emperor ransomed it with 5000 pounds of gold, 30,000 of silver, 4000 silk garments, 3000 skins of dyed purple, and 3000 pounds of pepper.

Stilicho beheaded. A. D. 408.

The faithless Alaric, though he for a while departed from Rome, soon appeared before it with a numerous army. Honorius attempted to avert the blow by a new treaty, but all such attempts were now vain: and Rome, the mistress of the world, was delivered up to the pillage of a Gothic army. After six successive days of plunder, the city was set fire to in several places, and was speedily reduced to a heap of ashes and ruins. All who took refuge in the churches were spared; but the infuriated Goths did not confine their hatred to those who were found in arms, and many of the principal inhabitants were massacred in cold blood. A storm of thunder and lightning is said to have added its devastations to those of the enemy, and to have completed the ruin of the last remains of Pagan idolatry.

Alaric was soon afterwards seized with a violent illness, which carried him off in the neighbourhood of Rhegium; but though the death of Constantine and some other usurpers left Honorius in the undisturbed possession of power, yet Gaul, Britain, and Rome, continued under the occupation of the barbarians till the death of Honorius, which took place in the 29th year of his reign.

The death of Honorius was followed by several usurpations of the sovereignty; but the title of emperor of the west was conferred on Valentinian the Third, whose mother, Placidia, was made regent during his minority. No sooner was he seated on the throne, than the empire was attacked by Attila, the celebrated leader of the Huns, whose exploits both on this and former occasions have been detailed in our account of his life. (See vol. III. p. 75.) Valentinian had rendered himself odious by his violence, his oppressions, and his incontinence, and in the 36th year of his age he was murdered by Petronius Maximus, to whose wife he had offered violence.

Maximus was immediately raised to the empire; but though he was desirous of retiring into private life, his friends persuaded him to abandon this resolution. After the death of his wife, he compelled the empress Eudoxia to marry him; but this high-spirited woman, who had been deeply attached to Valentinian, was so enraged at being married to his murderer, that she invited Genseric, king of the Vandals, into Italy. When Genseric appeared before Rome, a violent tumult took place, in which the emperor Maximus was killed. Genseric took and plundered the city, and carried off all the valuable articles which had escaped the rapacity of the Goths.

Rome was now reduced to the most deplorable condition; but its existence was for a while prolonged by the courage and virtues of Marjorianus, who was now raised to the empire. He drove the Vandals out of Italy, but he was soon afterwards murdered by Ricimer a Goth, who had long governed with absolute power. Marjorianus was succeeded by Anthemius, but when he began to govern in opposition to the wishes of Ricimer, the Gothic general revolted and took Rome, committing numerous cruelties, and putting to death the emperor Anthemius. Anthemius was succeeded in the empire by Olybius, who died

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soon after his accession. The supreme power was now usurped by Glycerius, who was deposed in 474, and succeeded by Julius Nepos. Nepos was driven from the throne by his general Orestes, who caused his own son Augustus to be proclaimed emperor. In the year 476, the barbarians who had served in the Roman armies, demanded the third part of the lands of Italy as the reward for their services; but as Orestes refused to grant this demand, they chose for their leader Odoacer, who became the first king of Italy.

From this period the history of Rome merges into that of Italy, and will be found fully detailed in our article on ITALY, Vol. XII. p. 333.

Romano.

ROMANIA, See TURKEY.

ROMANO, JULIO, or GIULIO PIPPI, a celebrated painter of the Roman School, was born at Rome in 1492. He was the favourite pupil of Raphael, and first signalized himself by his battle of Constantine, which he painted from a design of Raphael's, and which was particularly admired by Poussin.

When he had completed the hall of Constantine in the Vatican, from Raphael's designs, he went to Mantua, where the patronage of the Gonzaghi family excited him to those great works, and those magnificent plans by which Mantua and the palace *Del T.* have been so highly decorated. In the decorations of this palace, Julio prepared the cartoons, and had the pictures executed by his pupils; but he afterwards corrected and finished them. Modern pencils are said to have covered the touches of Julio, especially in the Fable of Psyche, the Allegories of Human Life, and the Giants Storming Heaven, where his composition and design are alone seen. In the fresco paintings of the old palace or corte of Mantua, which refer principally to the histories of the Trojan war, his peculiar merits are better perceived. Helen asleep,—Vulcan forging arms for Achilles, are considered beautiful; and Minerva slaying Ajax is regarded as sublime.

The most remarkable of the altar pieces of our artist are the three frescos of St. Marco; and in the church of St. Christofero, the athletic figure of that saint supporting the infant Jesus. His martyrdom of St. Stephen on the head altar of the Church of St. Stephen at Genoa, is preferred to them all.

Julio Romano possessed also great knowledge of architecture, and he executed plans for several of the palaces of Rome and Mantua. His last effort of this kind was the erection of a splendid mansion for himself at Mantua. On the death of St. Gallo, the architect of St. Peter's, Julio was chosen his successor by the pope; but the cardinal duke, by the entreaties of his wife and friends, prevented him from leaving Mantua; and while he was taking measures to surmount these difficulties, he was seized with an illness, of which he died in 1546, in the 54th year of his age. See PAINTING, Vol. XVI. p. 240.

ROME.

Rome.

ROME, the ancient capital of the Roman empire, and now the metropolis of the papal dominions, and the residence of the pope, is built chiefly on the left or eastern bank of the Tiber, which here runs in a southerly direction. The area enclosed by the walls of Rome approaches to the form of a square, and their circuit is about 16 miles. This area, however, comprehends an immense extent of unpeopled land; and a stranger may wander for hours in perfect solitude within the walls. This uninhabited portion of the area is to the south; but to the north of the plain of the Campus Martius, the bustle and activity of life reappears. This closely built part of the city is about two miles long, and from one to one and a half miles broad. In the time of the empire, Rome had 37 gates, 12 of which were double, one for those who entered, and the other for those who returned from the city. At present Rome has 16 gates, including the four of the Citta Leonina, but several of them have been walled up; the finest of these gates is the Porta Maggiore, which was originally an arch of the aqueduct of Claudian. It consists of immense squares of Tiburtine stone without cement, and sustained by huge Ionic columns. The other gates are the Porta del Popolo, on the north, which supplies the place of the ancient Porta Flaminia;—the Porta Sebastiana, which supplies the place of the Porta Capena on the south; the Porta Salaria, or Collina; the Porta San Paola, which is a substitute for the Porta Ostiensis; the Porta Pia, anciently the Porta Nomentana; the Porta San Lorenzo, probably the Porta Tiburtina; the Porta Giovanni, on the great road from Naples, corresponding to the ancient Porta Celimontana. The Porta Latina, between this last gate and the Porta Sebastiana, is blocked up; and close to the Porta Giovanni, on the right, as we leave Rome, is the Porta Asinaria, which is also blocked up.

The seven hills.

The seven hills on which ancient Rome stood, are the Palatine, the Aventine, the Capitol, the Cœlian, the Esquiline, the Quirinal, and the Viminal Hills. The first five have the appearance of small hills or large mounts; but the Esquiline and the Quirinal, though they have a considerable ascent on the side of Rome, have no descent on the opposite side; and the Viminal hill can no longer be recognized. The Aventine, Palatine, and Cœlian hills, and also part of the Esquiline, Viminal, and Quirinal Hills, are now covered with vineyards and corn fields.

Palatine hill.

The Palatine Hill, which is a square and flat topped elevation, is situated nearly in the middle of the other hills, and contains two solitary villas and a convent. Its numerous temples, palaces, porticos and libraries, are now heaps of shapeless ruins. The part of the imperial palace which looked to the west still exists, but it is now buried in ruins. The immense hall which was discovered here about a hundred years ago, and the ornaments of which were carried off by the Farnese family, is described by Eustace as an area covered with weeds, and presenting to the eye a vast length of naked wall.

Aventine hill.

The Aventine, the most western of the hills, is divided from the Palatine by the valley of the Circus

Maximus. Not a trace remains of any of the ancient and magnificent buildings which covered it. A few decaying churches and convents, half deserted, are the only objects which catch the eye. The principal edifices that stood on this hill, were the temples of Diana, Juno, and the Dea Bona. The west side of the Aventine looks down on the Tiber, and the fields called Prati del Popolo Romano. The Aventine has two distinct summits, divided by a valley. Near the base of the most southern of these, are the gigantic ruins of the baths of Caracalla.

Capitoline hill.

The Capitoline hill was originally called Saturnius, and afterwards Tarpeia. On the western side of the hill are still to be seen some remains of the ancient fortifications of the capitol. In some of the cottages on Monte Caprino, there are walls of extraordinary solidity, which seem to have formed the exterior of one of the towers of the citadel. These walls, built of blocks of peperin stone, are considered to be of the age of Camillus; and, excepting the Cloaca Maxima, to be the oldest of all the remains of antiquity in Rome. The temple of Jupiter Feretrius is supposed to have occupied this (the western) eminence; and that of Jupiter Capitolinus, the eastern summit of the hill. The common belief is, that the church of Ara Cœli stands on the site of the latter. The small square, having in its centre the equestrian statue of M. Aurelius, and enclosed by the three palaces of the senators, the conservatori, and the statue gallery, is supposed to have been the Intermontium. Beneath the senators palace are the remains of the south and west sides of an ancient building, consisting of large blocks of peperin stone. It is supposed to have been the Tabularium, where the public records were suspended on tables of bronze. In the interior of this building is an arched corridor of considerable extent, and of a noble style of architecture. The modern buildings on this hill are a convent of bare-footed friars, and the Palazzo Caffarelli, in the stables, cellars, and gardens of which, there are remains of the ancient fortifications of the citadel. The remains of the Julian or Mamertine prisons are still to be seen near the base of this hill, below the church of St. Pietro in Carcere.

The Cœlian hill.

The Cœlian Hill is crowned by the massive and lofty arches of Nero's aqueduct. Its precipitous banks are encircled by various ruins, by arches, recesses, niches, and passages, which are considered by some to have been the Nymphæum of Nero. An arched corridor, supposed to have formed part of the Vivarium, is to be found beneath the tower of the convent. The western extremity of this hill is occupied by the church of San Stefano Rotonda, the reputed temple of Claudius; and the great Basilica of St. John Lateran stands on its most eastern summit.

Esquiline hill.

The Esquiline hill is of great extent, and of a very indefinite form. A part of it is covered with the streets and edifices of modern Rome, and the rest of it is covered with the vestiges of buildings of every age, with deserted convents and papal churches, as well as with the ruins of ancient Rome. On its summit are the majestic arches of the united aqueducts of Claudius and Nero; and it contains also the lonely ruin of Minerva Medica, and various subterranean sepulchres and other ruins. The Esquiline has two summits, viz. L'Oppio, which is occupied by the church of St. Pietro in Vinculis, built upon part of the extensive baths of Titus, and Il Ciapio, now crowned with the basilica of Santa Maria Maggiore, but once the site of the temple of Juno Lucina.

Viminal hill.

The Viminal hill, which stands between the Esquiline and the Quirinal, is scarcely to be distinguished from either; and it must therefore be considered as forming a part of both.

The Quirinal hill is occupied with magnificent palaces, churches, streets, and fountains. The principal remains of antiquity which it contains, are the vestiges of the baths of Constantine, in the garden of the Colonna palace; and a part of those of Dioclesian, which were erected both on this and the Viminal hill. This hill is better known by the name of Monte Cavallo, in consequence of two colossal groups of a young man and horse, which were found in the ruins of the baths of Constantine, having been placed before the pope's palace on the summit of this hill. These figures are supposed to represent Castor and Pollux, and to have been the production of Phidias and Praxiteles, principally on the authority of the inscriptions upon them. The house of Scipio is supposed to have occupied the site of the Colonna palace and garden; and there is a little street, Vico de' Corneli, which has derived its name from that illustrious house. Having thus given a general notice of the seven hills of ancient Rome, we shall proceed to give a brief account of the principal remains of her ancient grandeur.

The ancient Forum extends from east to west, along the base of the Capitoline hill, and stretching to the base of the Palatine hill. Its four corners are considered to have been at the Church of Santa Martina and S. Luca on the N. E.; of Santa Maria della Consolazionne on the N. W.; the little church of St. Theodore, once the temple of Romulus, on the S. W.; and an unmarked point, where the arch of the Fabii once stood, within the line of the temple of Antoninus and Faustina, on the S. E. The ruins which now stand within these limits, are the triumphal arch of Septimius Severus, the temple of Concord or Fortuna, the column of the emperor Phocas, the ruined wall of the Curia, and the three columns of the Comitium, at the base of the Palatine. The triumphal arch of Severus, built of marble, stands at the base of the Capitoline hill. It consists of one large and two smaller arches, with an entablature supported by four Corinthian columns with pilasters. The whole of it is adorned with bas relief sculptures, representing Severus's triumph over the Parthians. The Ionic portico of the temple of Concord is all that remains; but it is now supposed to have been the temple of Fortune. The column of Phocas is a single Corinthian pillar, erected in the seventh century by the Exarch Smaragdus to the emperor Phocas. The only remains of the Roman curia or senate house, the site of which is occupied by the church of Santa Maria Liberatrice, is a high broken brick wall. The Comitium which stood in front of the curia, is now supposed to have been the owner of the three beautiful Corinthian columns called the disputed columns, which have been conjectured to be the remains of the temple of Jupiter Stator. Marble steps in front of them have been discovered by recent excavations. The three beautiful fluted Corinthian columns which were supposed to be the remains of the temple of Jupiter Tonans, stood on the declivity of the Capitoline. They formed the corner of its portico, and were erected by Augustus. The frieze is finely sculptured in bas relief, and the letters ESTITUER are the only remains of the inscription.

In quitting the forum by the Via Secondaria, we pass through the broken and defaced triumphal arch of Tiberius. It consists of a single arch, and only four of its eight fluted marble columns remain; two of which are entire. The interior of the arch is adorned with two bas reliefs, representing Titus in triumph, and the spoils of the temple of Jerusalem. On the roof is the apotheosis of the emperor. Through this mouldering arch are seen the ruins of the magnificent Coliseum, one of the grand monuments of ancient Rome. This amphitheatre is a structure of an oval form, 580 feet long, 470 broad, and above 1600 in circumference. It was erected by Vespasian out of a part of the materials, and on a portion of the site of Nero's golden house; and though its demolition was begun by the barbarous conquerors of Rome, yet it was so perfect in the thirteenth century, that games were exhibited in it for the amusement of the Italian nobility. Upon the revival of architecture in Rome, the Coliseum was used as a quarry both by the vulgar and the grandees, and Paul V. pulled much of it down in order to build his huge palaces. This system of depredation would soon have completed its destruction, had not Benedict XIV. erected a cross in the centre of the arena, and declared the place sacred, out of respect to the martyrs who had suffered within its walls. In no part of its vast circuit has the Coliseum been completely broken through, and in only a small segment is its external elevation preserved entire. In the interior the destruction of the building is deplorable. The marble seats are all torn away, the steps and vomitories overthrown, and the sloping walls and broken arches overgrown with the luxuriance of vegetation.* Here is a temporary wooden staircase, by which visitors ascend to the highest practicable point. See CIVIL ARCHITECTURE, Plate CLXXXVI. for a part of the elevation of the Coliseum.

The forums of the emperors were chiefly situated to the east of the Roman forum. The forum of Cæsar extended from the church of St. Adrian to the church of St. Cosmo and Damiano, and in the court of that convent are still to be seen some massy walls which are supposed to have been a part of the forum. The forum of Augustus, which contained the splendid temple of Mars, stood behind the present church of Santa Martina and S. Luca. Some fragments of walls belonging to the shops which encircled it still remain. The forum of Vespasian is supposed to have been in the vicinity of the temple of Peace. Of the forum of Nerva there are some beautiful remains at the Arca Pantani. They consist of three fluted Corinthian columns and one pilaster of Parian marble 50 feet high. They are supposed to have belonged to the beautiful temple of Nerva; the columns are flanked by a lofty wall of large masses of Tiburtine stone. The ruin of the temple of Minerva, situated in that part of the forum which was built by Domitian, consists of two marble Corinthian columns in front of a wall of Tiburtine stone. They are more than half buried beneath the pavement, and support a richly sculptured frieze. The forum of Trajan stood at the base of the Quirinal Hill. The centre of the Piazza Trajana, which contains Trajan's column, was excavated by the French to the level of the ancient pavement, and they brought to light various majestic columns of black oriental granite, once the supports of the Basilica Ulpia. The entrance to this forum (near the little church of Santa Maria in Campo Carleo) passed under the triumphal arch of Trajan. At the farther extremity stood the temple of Trajan, with the triumphal column in front of it, and in the centre the Basilica Ulpia, one of the most splendid buildings of any age. The steps that led to this Basilica may still be traced, and fragments of them are still strewed around. The portico of the temple consisted of eight immense columns of oriental granite, a fragment of one of which was six feet in diameter, and must have been 72 feet high. The column of Trajan, 140 feet high, is ascended by an easy winding staircase of solid Parian marble, lighted by loop-holes, and at the top stands the bronze statue of St. Peter which was placed there by Sextus V. (See CIVIL ARCHITECTURE, Vol. VI. p. 533.) In the midst of the forum of Antonius Pius, a little to the north of that of Trajan, stands the triumphal column of Marcus Aurelius, covered with the sculptures of his victories, and not much inferior to that of Trajan. The only other remains of the forum are the eleven beautiful Corinthian columns of Grecian marble, now built into the modern wall of the custom-house.

Trajan's column.

In the forum Boarium or market of Rome, stands the picturesque and magnificent ruin of Janus Quadrifrontis. It has four similar fronts, in each of which there is an arch of entrance, and it is built of immense blocks of Grecian marble. The brick walls on its summits are part of a fortress into which it was converted during the dark ages. At the side of the old church of St. Georgio in Velatri, is a little insignificant marble arch, erected by the trades people to the emperor Severus, who is sculptured upon it along with his wife Julia and his son Caracalla, that of Geta having been erased.

Janus Quadrifrontis.

Close to this forum stands the Cloaca Maxima, the most ancient of all the ruins of Rome, and considered the work of Tarquinius Superbus. The tunnel was once so large that a waggon of hay could pass through it. All that is now seen of it is the upper part of a grey massy arch of Peperin stone, as solid as it was on the day it was built. It is now choaked up nearly to its top by the artificial elevation of the surface of modern Rome; but it still serves as the common sewers of the city. Close to the Cloaca Maxima, is shown the celebrated fountain of Juturna.

Cloaca Maxima.

One of the largest and most beautiful temples of antiquity is the Pantheon or Rotunda, built by Agrippa. In our article on CIVIL ARCHITECTURE, Vol. VI. p. 622, we have given a full and detailed account of this interesting ruin, with the dimensions of all its parts, and we have likewise given a ground plan and accurate section of it in Plate CLXII.

Pantheon.

The temple of Vesta is a beautiful little building, near the Tiber, of Parian marble, and having a portico consisting of a circular colonnade of twenty fluted Corinthian columns. The French removed the modern wall that filled up the intercolumniation; but its coarse tiled conical roof resting immediately on the capitals, destroys the general effect. The circular altar built of marble, is converted into a chapel dedicated to La Madonna dell' Sole.

Temple of Vesta.

Opposite to this building is the church of Santa Maria in Cosmedin, built on the ruins of what is called the temple of Pudicitia Patrizia. The ruins within the church are the remains of a magnificent peripteral temple, with eight complete columns in front like the Parthenon. Six of the front columns may now be traced, and some of the lateral ones. The temples of Fortuna Virilis, of Peace, of Antoninus and Faustina, and of Faunus have been all described in our article on CIVIL ARCHITECTURE, Vol. VI. p. 533, 618, and most of them delineated in Plates CLIII. and CLXIV.

The church of S.S. Cosmo and Damiano is partly formed out of what is considered to have been the double temple of Romulus and Remus; the first having been circular, and the second square. Here was found

Temple of Romulus and Remus.

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* Sebastiano has published the Flora Colisea, containing 260 different plants. There are above 300; the finest of which are Papilionaceous.

the marble plan of Rome which had formed the pavement of the temple, and the broken fragments of which are fixed in the staircase wall of the Museum of the capitol.

The remains of the double temple near the Coliseum are supposed to be those of Hadrian's magnificent temple of Venus and Peace. The peristyles of this double peripteral temple had 12 columns in front, and 22 in depth of Parian marble, some broken remains of which are still seen. The whole was surrounded by a double colonnade, 500 feet long and 300 broad, of columns of oriental granite, with rows of capitols of Parian marble, the gigantic shafts of which are strewed around near Titus's arch. The platform of the colonnade, and the situation, and even steps of the temple, may yet be traced. The picturesque ruin called the temple of Minerva Medica stands in a solitary vineyard on the Esquiline hill. It is decagonal within. It is built of brick, and stripped of all its ornaments. The remains of the temple of Venus Erycina, consisting of the octagonal brick cella, stand in the circus and gardens of Sallust.

Theatre of Marcellus.

The only remains of the theatres of ancient Rome are those of the theatre of Marcellus. It was of Tiburtine stone, and consisted of four orders of arcades. The remains of this theatre are a portion of the two lower arcades, of which we have given a drawing in our article, Civil Architecture, Plate CLXXXVI.

Portico of Octavia.

The portico of Octavia consisted of a double row of marble columns, enclosing a large oblong square, enclosing the temples of Jupiter and Juno. Many of the beautiful columns of this colonnade are built up in the miserable houses of the Jews which now cover its ancient site. At No. 11, via di San Angelo in Peschiera are three magnificent fluted Corinthian columns of Grecian marble, supposed to be the remains of the temple of Juno.

Thermæ or baths.

Of the thermæ or baths of ancient Rome, the ruins of those of Titus, of Caracalla and Dioclesian, are all that now remain. The baths of Caracalla are situated at the base of the south summit of the Aventine hill. They are now a mass of roofless ruins of almost immeasurable extent, filled with tremendous fragments of broken wall, and overgrown with weeds and brambles.

Beside the immense halls, one of which was 150 feet long, and covered with a flat roof of stone, there are the remains of a large circular building, and other smaller ones. A broken staircase leads to the top of the ruins.

Baths of Titus.

The part of the baths of Titus which has been excavated, is near the Coliseum. After passing the mouths of nine long corridors, we enter the portal of what is called the house of Mæcenas, and then arrive at a damp and dark corridor, the ceiling of which is still adorned with some of the most beautiful specimens that now remain of the paintings of antiquity. After examining these arabesque paintings, the visitor enters magnificent halls, whose ceilings are beautifully painted with fantastic designs. In one of these dungeons, 36 of which have been opened, is shown the remains of a bath supposed to have been for the private use of the emperor, and in another is seen the crimson-painted alcove, in which the Laocoon was found in the time of Leo X. The French found in those chambers the Pluto and the Cerberus. It is said that miles of these baths remain unexplored.

Baths of Dioclesian.

The baths of Dioclesian are scattered over the summit of the Quirinal and Viminal hills, and they are said to have surpassed all the thermæ of ancient Rome. They seem to have formed an immense oblong square, with a circular hall at two corners which are still standing. One of these halls, which is much dilapidated, has been used as a granary, and the other has been transformed into a church. The Xystum, or great covered hall of the thermae, was converted into the church of Santa Maria de Angeli by M. Angelo. It is a hall 350 feet long, and 90 high. The vaulted roof is supported by sixteen Corinthian columns, eight of which only, of Egyptian granite, are ancient. The Meridian, traced on the pavement in 1701 by Bianchini, still remains.

Among the autiquities of Rome, the bridges are not the least remarkable. We have, however, already treated the subject in our article Bridge, Vol. IV. p. 482, and have given representations of the Pons Milvius, and the Pons Senatorius in Plate LXXXII.

Among the ancient arches is that of Claudius Drusus Nero, which is close to the present Porta San Sebastiano. It consists of a single arch, and is built of marble and Tiburtine stone. The two columns of African marble are supposed to be of a later age. The arches of Titus and of Severus have already been described. The arch of Constantine is in fine preservation. Its sculptured medallions and bas reliefs which commemorate the victories of Trajan, are supposed to have been torn from one of his triumphal arches. This arch consists of eight fluted Corinthian columns of marble, which support the figures of eight Dacian captives; one column one Dacian, and all the eight heads very modern. The arch of Gallienus is a building of mean architecture, on the Esquiline hill, near the church of Santa Maria Maggiore. The arch of Dolabella and Silanus stands on the Cœlian hill, near the church of San Tomaso in Formis.

The only remains of the celebrated aqueducts of ancient Rome, are those of the Martian and Claudian aqueducts. The long and broken lines of these lofty arches stretch over the Campagna to the south, that of Martian was built by Quintus Martius in the time of the republic. That of the emperor Claudius was carried through the hills and across the valleys of Latium for a distance of 50 miles.

The first obelisk was brought to Rome from Egypt by Augustus, and now stands on Monte Citorio. The obelisk of Rameses is the loftiest that was ever brought from Egypt. Though now patched together, it rises to a hundred feet in front of the Lateran church. The two obelisks that stood at the entrance of the mausoleum of Augustus, were brought to Rome by Claudius. One of them stands in front of Santa Maria Maggiore, and the other on Monte Cavallo. The obelisk found in the circus of Caracalla stands on the Fountain of the Piazza Navona. The obelisk in the grand piazza of St. Peter's is in the most perfect preservation, and was brought from Egypt by Caligula. The obelisk which stood in the circus of Sallust, occupies the summit of the Pincian hill.

On the Appian way are many remains of the ancient tombs of the Romans. The tomb of the Scipios is one of the most celebrated: The inscriptions have been placed in the Vatican. On the opposite side of the road to this tomb is that of the Maniglia family. The tomb of Cecilia Metella, the wife of Crassus, is reckoned one of the most beautiful of sepulchral monuments. It consists of a round tower of immense blocks of Tiburtine stone, adorned with a Doric marble frieze, on which are sculptured ram's heads, festooned with garlands of flowers. This beautiful tower rests upon a square base-ment, partly buried. The interior of the wall is built of brick, and the wall itself is at least twenty feet thick. The sepulchral vault was opened in the time of Paul V. and the beautiful marble sarcophagus of Cecilia Metella was carried to the Farnese palace.

The grey pyramidal tomb of Caius Cestius, near the Porta San Paolo, is more than a hundred feet high, and is entirely built of marble. Within this tomb may be seen by the light of torches some specimens of ancient painting. One foot of the colossal statue in bronze of Caius Cestius is now in the Museum of the Capitol, and is all that remains of it. The mausoleum of Augustus, erected on the banks of the Tiber, was encircled with three ranges of vaults. The remains of it consist of small sepulchral cells, communicating with each other. In one of them, said to have contained the ashes of Augustus, was a heap of charcoal.

About two miles from Rome, on the Via Nomentina, is the mausoleum of Santa Constantia, the daughter of Constantine the Great, which was converted into a church. In the inside there is a double range of granite columns. The sarcophagus, now in the Vatican, is of porphyry. This building has been called the Temple of Bacchus. At the same distance from Rome, beyond the Porta Maggiore, on the Via Labicana, is the tomb of the empress Helena, the mother of Constantine. A part only of its immense ruined circle now remains. It contains a small neglected church. The immense porphyry sarcophagus which it enclosed, is placed in the Vatican. From this church the catacombs may be entered, which extend miles under ground. At the church of St. Sebastian, they have been explored for fifteen miles. These excavations seem to have been gradually formed by the digging out of puzzolano. The cavities for the dead are hollowed out horizontally in the soft puzzolano rock, three or four tiers, one above another. All of them are empty, and almost all seem from their size to be for children. Hence it is probable that they were places of burial for pagan children.

On the Via Appia, there are still some interesting antiquities to be described. The fountain of the nymph Egeria lies in a little green valley, about a mile from Rome. The grotto is excavated on the steep side of the bank, in a long and deep recess, with a vaulted roof, and niches at the side for statues. At the top is the reclining marble statue of a river god, from which flows the most delicious water. The capillaire plant overhangs the sides of the grotto. On the hill above is a temple of brick, with a portico of four marble corinthian columns of white marble, which was supposed to have been the temple of the Muses; but a votive altar having been dug up, containing the name of a priest of Bacchus, it is now believed to have been the temple of Bacchus. In redescending the hill, there is seen in a green valley a neat little brick building, decorated with Corinthian pilasters of red and yellow brick, which has been called the temple of Rediculus, who persuaded Hannibal to retreat from Rome.

On the Via Latina, the road to Frascati, on an eminence to the right, stands a brick building, adorned with brick pilasters, supposed to have been the ædicola of Fortuna Muliebris, erected in commemoration of the patriotism of Veturia and Volumnia. It probably therefore stands on the spot occupied by Coriolanus's camp. This temple resembles that of Rediculus. It has several small windows in the upper apartment. It commands a fine view of the broken arches of the Claudian and Martian aqueducts.

On the right of this stands the ruins of Roma Vecchia, which consist of numerous ruined brick buildings, without roofs, but very lofty, one of which, with three large windows in front, and three niches within, may have been the Basilica. In another place are two ranges of covered arches, supporting a vaulted and stuccoed roof, which may have been a reservoir of water.

Having thus endeavoured to give a brief description of the remains of ancient Rome, we shall now proceed to describe the modern city, including the buildings of the dark and of the middle ages.

Modern Rome.

Streets.

The streets of Rome are in general narrow, gloomy, irregular, and dirty, being narrower than those of London, and wider than those of Paris. They have seldom any foot pavement. They are often very long and strait, and sometimes terminating in a church, a fountain, or an obelisk. Three of the present streets diverge from the Piazza del Popolo, near the Pantheon Gate, viz. the Corso, the Strada del Barberino, and the Strada de Ripetta. The Corso, so called from being the race course, was anciently the Via Lata, extends a mile in length, in a direct line from the above piazza, to the base of the Capitoline hill, but though it is lined with churches, and palaces, and handsome edifices, its general effect is far from good. Among the other good streets are the Strada Giulia, the Strada della Langara, the Strada Felice, the Strada Maggiore, and the Strada Pia.

The houses of Rome are partly of stone and partly of brick, and are frequently plastered or stuccoed as at Vienna. Marble is not common.

Eustace informs us that modern Rome contains 46 squares, 5 monumental pillars, 10 obelisks, 13 fountains, 22 mausoleums, 150 palaces, and 346 churches.

Squares.

The area in front of St. Peter's may be ranked among the squares of Rome. It is large, and of an oval shape, encircled with a fine colonnade by Bernini. In the middle stand two elegant fountains, and the Egyptian obelisk already described. The Piazza Navona, on the side of the Circus Agonalis, is adorned by the handsome church of St. Agnes, and many elegant houses. It is of an oblong shape, and its principal ornament is the fountain in its centre, erected by Bernini. It consists of a circular basin, 73 feet in diameter, containing a mass of artificial rock, to which are chained four river gods, and which supports the Egyptian obelisk brought from the circus of Caracalla. Each of these gods sends out his own stream, which, after falling down the rock, loses itself in the ocean of the basin. In a cavern in the rock is a lion and a horse. The fountain is contrived so as to overflow annually. The Piazza d'Espagna, so called from its containing the palace of the embassy, is adorned with a fountain, and several handsome buildings, but chiefly by the noble flight of marble steps that lead from it to the obelisk, church, and square of Della Trinita di Monti, which extends along the brow of the Pincian hill, and commands a fine view of Rome, Monte Mario, and the Janiculum. The Piazza of Monte Citorio, which is very beautiful, is ornamented with the Curia Innocensiana, or palace erected by Innocent XII. for courts of justice. The Piazza de Campo Marzio is small, and is to a great degree covered with buildings. The Piazza de Monte Cavallo, which stands on the Quirinal hill, is one of the finest in Rome, and contains the two marble horses already mentioned. We have already spoken of the Roman Forum, and of the small square of the Intermontium. The principal obelisks of Rome, as objects of antiquity, have already been noticed.

Obelisks.

Fountains.

Among the fountains of modern Rome which are particularly admired by strangers, are the Fontana

Felice, the Fontana Paolina, and the Fontana di Trevi. The Fontana Felice, in the Piazza del Termini, on the Viminal hill, is supplied by the Aqua Claudia. It discharges itself through a rock under an Ionic arcade of white stone, cased with marble. Among its gigantic statues are Moses striking the rock, Aaron conducting the Israelites, Gideon leading his soldiers to the torrent, and below are four lions, two of marble, and two of basalt. This fountain was restored by Sextus V.

Fontano Paolina.

The Fontana Paolina, situated in a deep evergreen shade, stands on the brow of the Janiculum. It consists of an arcade, supported by six pillars of granite. Here torrents from the summit of the hill rush through the three principal arches into an immense marble basin, whose surface is agitated like the waves of a lake by their concussion. The waters then roll down the sides of the mountain, turn several mills as they descend, and supply numerous reservoirs below. The lofty situation of the fountain commands one of the finest views of Rome, and the plain of the Campagna, bounded only by the ridge of the Appennines. "The trees," says Eustace, "that line its sides and wave to the eye, through its arches, shed an unusual beauty around it; and the immense bason which it replenishes, gives it the appearance, not of the contrivance of human ingenuity, but almost the creation of enchantment."

Fountain of Trevi.

The fountain of Trevi, in the Piazza di Trevi, is the finest in Rome, and probably the most magnificent in the world. On a huge rough and broken rock, rises a palace adorned with Corinthian pilasters, and supported in the centre by vast Corinthian pillars. It is ornamented with statues. In the middle of the edifice, between the columns, under a rich arch, stands Neptune in his car, in a majestic attitude. Two sea horses, led by two tritons, drag his chariot, and "emerging from the caverns of the rock, shake the trees from their roots, while the obedient waves burst forth in torrents on all sides, roar down the clefts of the crag, and form a sea around its base." The basin is of white marble, and the enclosure around it is flagged and lined with the same stone. A flight of white marble steps leads down to the basin.

Churches.

Rome is superior to all the other cities of Europe in the number and splendour of its churches. The church

St. Peter's.

of St. Peter has long been one of the wonders of the modern world. When the spectator approaches the entrance of the square in front of St. Peter's, he sees four ranges of lofty pillars, retiring in a bold semicircle to the right and left, containing the obelisk already noticed. Before him he perceives the stupendous front of St. Peter's, towering to the height of 180 feet, and raised on three successive flights of marble steps, extending 400 feet in length. Far behind and above this, rises the dome of St. Peter's, to the height of 400 feet. The plan and the external architecture of St. Peter's have already been represented in Plate CLXXIV, of CIVIL ARCHITECTURE, in contrast with our own national cathedral of St. Paul's.

The interior of St. Peter's corresponds with the grandeur of the exterior. Five lofty portals open into the portico, (a gallery equal to the most spacious cathedral) 400 feet by seventy high and fifty broad, paved with variegated marble, covered with a gilt vault, adorned with pillars, mosaics, and terminated at each end by an equestrian statue,—one of Constantine, and the other of Charlemagne. A fountain at each end refreshes the air. Opposite the five portals, are the five doors of the church. The middle one has folding doors of bronze, and three have pillars of the finest marble. On entering it, there is seen the most extensive hall ever built, paved with variegated marble, and roofed with a gilded vault. The view from the foot of the altar, in the centre of the church, is truly magnificent. Four superb vistas appear around you, and the dome rises above like the firmament, to the height of four hundred feet, covered with mosaics of religious history, and crowned with the throne of the Eternal. Around the dome rise four other cupolas of inferior magnitude, and six more cover the different divisions of the aisles, and other six as many chapels or churches. All these cupolas are lined with beautiful mosaics, and the aisles and altars are variegated with every species of ornament, and with the finest sculptured monuments. The high altar which stands under the dome is a most striking object. At its corners, there rise from four ivory pedestals, four twisted pillars fifty feet high, supporting an entablature, and bearing a canopy rising to the height of 132 feet from the pavement. All this, excepting the pedestals, is of Corinthian brass, and is the most lofty or massive work of that or of any other metal in the world. This brazen edifice is so disposed as not to obstruct the view of the cathedra or chair of St. Peter, which terminates the church. This is also of bronze, and consists of a group of gigantic statues of the four doctors of the Greek and Latin churches, supporting the patriarchal chair of St. Peter. The chair is a throne elevated seventy-five feet above the pavement; and a circular window, tinged with yellow, throws from above a mild radiance around it.

At the west end of the high altar of St. Peter's is the descent by a double flight of marble steps, to the tomb or confession of St. Peter. These steps lead to an area before two brass folding doors, which conduct into a vault whose grated floor is right above the tomb. The rails that surround this space above, are adorned with 112 bronze cornucopias, which support as many silver lamps, that burn constantly in honour of the apostle. The stair case, the pavement of the area, and the walls around, are lined with alabaster, lapis lazuli, verde antico, &c.

The Sacre Grotte, which is on a level with the above pavement, has its regular entrance beneath one of the great pillars that support the dome. This grotto, consisting of several long winding galleries, stretching under the first building in various directions, is the remains of the ancient church built by Constantine. The beautiful passage in which Mr. Eustace describes his feelings in traversing this grotto, deserves to be read by every Christian. "I may be pardoned, says he, when I acknowledge that I felt myself penetrated with holy terror, while conducted by a priest in his surplice, with a lighted torch in his hand, I ranged through these dormitories of the dead, lined with the urns of emperors and pontiffs, and almost paved with the remains of saints and martyrs. The intrepid Otho, the turbulent Alexander, and the polished Christina, lie mouldering near the hallowed ashes of the apostles Peter and Paul, and the holy pontiffs Linus, Sylvester, and Adrian. The low vault closes over their porphyry tombs, and silence and darkness brood uninterrupted around them. They were increased as I approached the monument of the apostles themselves. Others may behold the mausoleum of an emperor or consul, a poet or an orator, with enthusiasm; for my part, I contemplate the reputation of these Christian heroes with heart-felt veneration. What if a bold achievement, a useful invention, a well-fought battle, or a well-told tale, can entitle a man to the admiration of posterity, and shed a blaze of glory over his remains,—surely the courage, the constancy, the cruel sufferings, the triumphant death of these holy champions, must excite our admiration and our gatitude, ennoble the spot where their relics repose, and sanctify the very dust that imbibed their sacred blood. They enlightened the world by their doctrine, they reformed it by their example, they devoted their lives to the propagation of truth, and they sealed their testimony with their blood. They are therefore the patriots of the world at large, the common benefactors of mankind; and, in the truest and noblest sense, heroes and conquerors."

The vestry or sacristy of St. Peter's is a splendid building, connected with the church by a long gallery, and ornamented with mosaics, statues, and paintings. It is indeed a large church, covered with a dome, and surrounded with chapels.

The dome of St. Peter's is ascended by a well-lighted and broad paved staircase or road, of such gentle acclivity, that there is a continual passage of horses and mules upon it, which go up laden with stones and lime. Crowds of workmen are seen passing and repassing, and the whole has more the appearance of a town than of a single building, from the small houses and ranges of workshops necessary for the constant repairs of the church. The traveller can now examine closely the construction of the dome, the vast square platform on which it rests, the lofty colonnade that rises on that platform, and the double dome of solid stone of such prodigious magnitude; and the lantern which, like a little temple, stands on its summit.

The church of St. Clement is the most ancient church in Rome, having been built on the site of the house of the bishop of that name. A plan of it is given by Eustace; and it is deemed one of the best models of the original form of Christian churches.

The church of S. Pietro in Vincoli, built about 420, is a noble hall, supported by twenty Doric pillars of Parian marble, open on all sides. Among its monuments, is a sarcophagus of black marble, of exquisite form; and the tomb of Julius II. distinguished by the celebrated and wonderful statue of Moses by Michael Angelo.

The church of St. Martin and St. Sylvester is formed out of the ruins of the neighbouring baths of Titus. It is one of the most beautiful buildings in Rome. It is supported by Corinthian columns of the finest marble, and the aisles are adorned by the paintings of the two Poussins.

The church of St. Andrea on Monte Cavallo by Bernini, though very small, is highly finished and very beautiful, both for its form and the marbles that line its oval exterior.

That of St. Cecilia in Trastevere is remarkable for its great antiquity and magnificence. Over the tomb of St. Cecilia is a fine statue by Stefano Moderno, of the saint, representing the exact attitude and drapery in which the body was discovered in the tomb in 821. It is deemed very beautiful.

The church of St. Pietro in Monterio on Monte Janiculum, enjoys the finest view of the ancient and modern city. The church is not handsome, but it was once celebrated for its sculpture and paintings, among which was the Transfiguration by Raphael. It was said to have been in a bad light here, though Raphael painted it for this very position. In the middle of the little square of the convent belonging to this church, is a round chapel in the form of an ancient temple, supported by sixteen pillars, and terminated by a dome. It was designed by Bramanti, and is much esteemed. Raphael has introduced it into his cartoon of Paul preaching at Athens.

The church of Santa Maria in Trastevere is a bold and majestic building, distinguished by its simplicity. The vault and chapel are adorned with fine paintings by Domenichino.

The church of S. Grisagono is remarkable for its numerous columns of granite, porphyry, and alabaster, which support its nave and choir; and that of S. Giovanni Paoli is still more splendidly adorned with pillars and ancient ornaments.

The church of St. Gregorio Magno is celebrated by the rival productions of Guido and Domenichino on the walls of its chapel.

The church of San Onofrio is celebrated for containing the remains of Tasso, which lay for many years without a monument or even an inscription. At last this piece of justice was done to his memory by the cardinal Bevilacqua.

The church of St. Sebastiano has a handsome portico and several good paintings, but it it best known as the principal entrance into the catacombs in its vicinity.

The church of Madonna del Sole is the ancient temple of Vesta, stripped of its entablature, curtailed and disfigured. The cella and pillars of white marble remain.

The church of Santa Maria Egizeaca is the temple of Fortuna Virilis, and that of Miranda stands on the ruins of the temple of Antoninus and Faustina. The church of Ara Cœli, which crowns the summit of the Capitoline, is supposed to occupy the site of the temple of Jupiter Capitolinus. It is adorned within with twenty-two ancient columns; and on the outside with a flight of 124 steps of Grecian marble, said to have formed the ascent to the temple of Romulus Quirinus.

Seven Basilicæ.

The seven great churches or patriarchal Basilicæ, are the cathedrals of the sovereign pontiff, in which he occasionally officiates, reserving the high altar entirely to himself; and they possess the privilege of granting 6000 years indulgence to the penitent who shall visit them in one day. These seven churches are St. Peter's, St. John Lateran, Santa Maria Maggiore, St. Paul without the walls, Santa Croce, St. Lorenzo, and St. Sebastian.

St. John Lateran.

The church of St. John Lateran, founded by Constantine, is the regular cathedral of the bishop of Rome, and assumes the title of the parent and mother of all churches. The principal portico, which is of the composite order, consists of four lofty columns and six pilasters. The decorations of the church are rich in the extreme. It was anciently supported by more than 300 antique pillars, but the architect walled them up in the buttresses. In a semicircular gallery, there is an altar decorated with four ancient columns of gilt bronze, which are unique; and are said to be the identical columns made by Augustus out of the rostra of the ships taken in the battle of Actium, and dedicated by Domitian on the Capitol. The Corsini chapel in this church, in the form of a Greek cross, is reckoned one of the most perfect buildings of the kind. The ancient marbles which line its walls, the columns which sustain its rich frieze of sculptured bronze, its gilt dome, the polished marbles of its pavement, and the magnificent tombs of its popes are said to surpass conception. The tombs, with the statues, are much admired, particularly that of Clement XII. who was entombed in a large and finely shaped antique sarco-

Corsini chapel.

phagus of porphyry, originally found in the portico of the Pantheon.

Santa Maria Maggiore.

The Basilica Liberiana, or church of Santa Maria Maggiore, stands on the highest of the two summits of the Esquiline hill, in the midst of two great squares, which terminate two streets nearly two miles long. It is supposed to occupy the site of the ancient temple and grove of Juno Lucina. The principal front consists of a double colonnade; the lower Ionic, the upper Corinthian; and before it is a Corinthian pillar, supporting a brazen image of the blessed virgin. On entering the church, there appear two magnificent colonnades lining the nave, and separating it from the aisles. They are each supported by more than twenty pillars. The Ionic pillars are thirty feet high, and the length of the colonnade 250. The altar is overshadowed by a large canopy of bronze, sustained by four lofty Corinthian columns of porphyry. One of the chapels was built by Sextus Quintus, and contains his tomb. A chapel on the opposite side, belonging to the Borghese family, surpasses it in decorations. In the latter, bronze, marble, lapis lazuli, jasper, and the more precious stones, cover the walls with a blaze of ornament.

St. Paul.

The Basilica of St. Paul, without the walls, at some distance from the Porta Ostiensis, is one of the grandest temples erected by Constantine on the spot of the apostle's martyrdom. This church is said by Procopius to have been held in such veneration, that Theodosius and Honorius built a portico from the gate to the Basilica, a distance of nearly a mile. This portico, which seems to have equalled the greatest works of the ancient Romans, was supported by marble pillars, and covered with gilt copper, but not a trace of it now remains. The interior of the church is of ancient brick. The portico is supported by twelve pillars; the principal doors of bronze, and the nave and double aisles are supported by about 80 Corinthian columns in double rows, 24 of which are of Pavonazzo marble; the walls and arches rest upon 12 other columns, and 30 more decorate the apostle's tomb. These pillars are in general porphyry, and the 4 that support the central arches are of vast magnitude. The church is 300 feet long and 150 broad, and it exhibits the finest collection of pillars now known.

SantaCroce.

The church of Santa Croce in Gierusalemmo stands in a solitary situation on the Esquiline hill, close by the walls of Rome, and near the Claudian aqueduct. It was erected by Santa Helena, the mother of Constantine on the ruins of a temple of Venus and Cupid. It derives its name from some pieces of the holy cross, and a quantity of earth taken from Mount Calvary and deposited in it by its founder. It is remarkable only for its antique shape, and the eight magnificent ancient columns of oriental granite that support its nave; two of these, which support the canopy of the altar are of the Peacock's eye marble. Beneath the altar is the beautiful bagnaruola, a bath of some ancient Roman, formed out of one block of basalt. Its front, which is modern, is of rich materials, but indifferent architecture.

Lorenzo.

The church of St. Lorenzo was built by Constantine on the Via Tiburtina, about a mile from the Porta San Lorenzo, and over the tomb of the martyr of that name. It is distinguished by ten magnificent columns of pavonazzetta marble buried nearly to the top of their shafts below the pavement of the old church. On the right hand side, in walking up the nave, is the Ionic column having a frog and lizard sculptured on its capital, and which is considered as the very column which Pliny mentions as having been that marked by two Spartan architects, Battroccus and Saurus. It must, therefore, have been brought here from the temple of Jove in the portico of Octavia. The frog is sculptured in the eye of one volute in place of the rose, and on the other the lizard, in its own natural posture, encircles the rose.

The three pontifical palaces in Rome are the Lateran, the Quirinal, and the Vatican. The Lateran is a palace of great extent, adjoining the church of the same name, and a part of which is reserved for the pontiff, when he performs service in the church.. The main body of the building was turned into an hospital for the reception of 250 orphans by Innocent XI.

The Quirinal palace on Monte Cavallo is the summer residence of the Pope. It has two long, plain, and unadorned fronts. The court within is about 350 feet long and about 900 wide; a broad and lofty portico runs along it on every side and terminates in a grand staircase leading to the papal apartments, chapel, &c. The adjoining gardens are spacious, and are ornamented with rivers, natural and artificial brooks, and by statues, urns, and other objects of antiquity. We have already mentioned the obelisk of the colossal horses. The principal paintings here are Guercini's Madness of Saul; Caravaggio's Christ and the Doctors; the original sketch of the Transfiguration; Domenichino's Ecce Homo; Bartolomew's St. Peter and St. Paul, and some paintings by Carlo Maratti. There is here a small chapel painted by Guido.

The Vatican hill gives its name to the palace and church which stand upon its declivity. The Vatican was erected by different architects, and is more an assemblage of palaces than a regular palace. It covers a space of 1200 feet in length and 1000 in breadth. The number of its apartments is reckoned to be 10,000, and its halls and palaces are on a scale of grandeur truly Roman. The grand entrance is from the portico of St. Peter's by the Scala Regia, the most superb staircase in the world, composed of four flights of marble steps with a double row of marble Ionic pillars. This leads to the Sala Regia, a hall of great length and height, communicating by six folding doors with as many other apartments. At one end of the Sala Regia is the Capella Paolina, the altar of which is supported by porphyry pillars, and bears a tabernacle of rock crystal. On the other end of the hill on the left is the Sistine chapel, containing on its walls and vaulted ceilings the fresco paintings of Michael Angelo and his pupils, which are its only ornaments. The Last Judgment of Michael Angelo occupies one end entirely. Opposite to the Sistine chapel a folding door leads into the Sala Ducale, a very large hall. Hence the visitor passes into the Loggio de Raffaelli, a series of open galleries in three stories, lining the three sides of the court of St. Damasus. These galleries were either painted by Raphael or by his scholars. The first gallery in the middle story is the only one executed by Raphael or retouched or corrected by him. The thirteen arcades that form this wing of the gallery contain representations of the history of the Old and part of the New Testament. The first compartment represents God with arms and feet expanded darting into chaos, reducing its distracted elements into order by the word of his command. This representation is said to have astonished Michael Angelo. From one of the galleries a door opens into the Camere de Raffaello, which are a range of unfurnished halls, the walls being covered with figures.

Two antichambers, adorned with the paintings of great masters, lead to the first hall, called the Hall of Constantine, because it is adorned with the achievements of that emperor. The second chamber contains the story of Heliodorus from the Maccabees, the interview of Pope Leo and Attila, the miracle of Bolsena, and the fine picture of the liberation of St. Peter from prison. The third chamber contains the School of the Philosophers, the Debate on the Sacrament, the Judgment of Solomon, and Parnassus with its groves of bays, Apollo, the Muses, and the poets whom they inspired. The fourth chamber contains the Burning of the Borgo San Andre, the Victory of Pope Leo over the Saracens at Ostia, and the Coronation of Charlemagne. These paintings are the work of Raphael.

From these state apartments of the Vatican, we pass to the Belvidere, so called from its elevation and prospect, and, advancing along an extensive gallery, we reach an iron door, which conducts us into the library of the Vatican. The books are all kept in cases, and are not seen. Their number, Eustace says, has been estimated at 2 and 400,000, while others raise it to a million, but a more recent author says that it scarcely possesses 40,000. The usual entrance into the library is by the office of that of the clerks, or writers of the principal European languages who are attached to the library. Passing through an anti-room, you enter a hall 200 feet by 50, painted in fresco. In this hall there is a column of oriental alabaster, for the baths of the emperor Gordian, and other curiosities. At both ends of this hall is a long gallery, the one being terminated by the sacred, the other by the profane cabinet; the former being a collection of Christian, and the latter of Pagan antiquities. The first consists of curiosities from the catacombs, carvings of Madonnas, martyrdoms in bas reliefs, &c. The adjacent chamber of the Papyrus, decorated by Raphael and Mengs, is highly admired. The pavement is of the richest marble, and the walls are enamelled with giallo and verde antico, with porphyry, and pilasters of oriental granite of the highest polish. The papyrus MSS. are enclosed in the walls in long columns under glass. At this end the late Pope has added some rooms, in which the books are both visible and tangible, and in which there is a fine collection of Greek vases. There is a good cabinet of medals in the library, and also a collection of prints. At the other end of this immense gallery is the profane cabinet, which possesses a grand collection of antiques, particularly of bronze. Here there are some types for stamping, approaching closely to printing types. There are here several lead water pipes marked with the plumber's name; and perhaps the most singular curiosity is the long hair of a Roman lady, found in a tomb in the Appian way, and in a state of perfect preservation.

The grand gallery which leads to the library terminates in the museum Pio-Clementinum, begun by Clement XIV. and completed by Pius VI. It consists of several apartments, galleries, halls, and temples, some lined with marble, others with mosaic pavement, and all of them full of statues, altars, tombs, candelabra, and vases. Three anti-chambers, called Il vestibolo Quadrato, Il vestibolo Rotondo, and La Camera di Baccho, lead to a court more than 100 feet square, with a portico supported by granite pillars, and decorated by antiquities of all kinds; with the Apollo Belvidere, the Laocoon, the cartoons and the Torso. Next to the court is the hall of animals, furnished with the ancient statues of animals. At one end this hall opens into the gallery of Statues, containing on each side exquisite statues of Greek and Roman sculpture, and terminated by three apartments called the *Stanze delle Buste*. The busts rest on tables or stands of ancient workmanship, and commonly of the most curious and beautiful marble. At the opposite end of the gallery is an apartment called *Il Gabinetto*, adorned by the united arts of painting, sculpture, and architecture. Its roof is supported by eight columns of alabaster. The place shines with ancient mirrors, and its roof is adorned with the events of history and mythology. This cabinet communicates by an open gallery with the Stanze delle Buste on one side, and the hall of animals on the other. Through a noble pillared vestibule we now enter the temple of the Muses, an octagon supported by sixteen pillars of Carrara marble with ancient capitols, and paved with ancient mosaics. Next to the temple of the Muses is the Sala Rotonda, a lofty dome, supported by ten columns of Carrara marble, paved with the largest mosaics yet found. In the middle is a vase of porphyry, fifty feet in circumference, or forty-two, according to a later author. This hall is appropriated to colossal statues, among which are Ceres, Juno, Lanuvina, Hadrian, Antinous, Jupiter, Jupiter Serapis, and Ocean. From the Rotonda, which is reckoned the finest hall in the museum, a rich portal leads to the Sala a Croce Greca, supported by columns, and paved with an ancient mosaic brought from Cicero's villa. Here is a vast sarcophagus, formed with its lid of one block of red porphyry, adorned in basso relievo with little cupids. This once contained the ashes of Constantia, the daughter of Constantine.

This last hall opens on a double staircase raised on twenty-two pillars of red and white granite, with marble steps and a bronze ballustrade. The middle flight leads to the Vatican library, the other two to the gallery of Candelabra, a long gallery of six compartments, separated by columns of rich marble. This gallery contains various candelabra with vases and other objects of antiquity. At the end of this long suite of apartments a door opens into the *Galleria de Quadri*, containing a collection of pictures by the Italian masters. On the left, before descending the above-mentioned staircase, there is a beautiful little circular temple of marble, called the Stanze della Biga, from the biga or triumphal car of richly sculptured marble which stands in the centre, drawn by two fiery steeds of bronze. It is adorned by four bas reliefs, a statue of Auriga, and a fine discobolus. Besides these galleries, there is the long geographical gallery, with maps of the Italian mountains and rivers on its walls, and the tapestry chambers hung with tapestry woven in Flanders, and copied from the cartoons of Raphael.

Museum of the Capitol.

Among the other objects of public interest at Rome, is the museum of the Capitol, consisting of splendid halls and galleries, filled with the treasures of ancient sculpture, which it is impossible here to enumerate, far less to describe. The museum of paintings in the Capitol is contained in the opposite Palazzo di Conservatori, in which there are likewise many objects of antiquity. The paintings are coarse, and inferior in interest to the sculptures in the other museum.

Modern palaces.

The limits of this article, already overstepped, will not permit us to give any account of the palaces or family residences of the nobility in Rome. In many of the palaces the lower stories have grated windows, and no glass. In others they are used as shops, while the middle story is let out as lodgings, and the noble families who own them, inhabit the upper story. The Fiano palace, for example, has shops below. The

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upper stories are occupied by twenty different families, and the duke and dutchess live in a corner of it.

Modern Palaces.

The great families, however, of Doria, Borghese, and Colonna, are sufficiently wealthy to support their hereditary dignity; and their palaces are filled with their own families or dependants. We are told, however, that butter is sold regularly at the Doria palace every week. All the ancient palaces have in the entrance hall a state crimson canopy, where the prince sits on a throne, to hear the complaints and redress the grievances of his vassals.

The Doria palace has three vast fronts; the staircase, supported by pillars of oriental granite, conducts to a magnificent gallery, occupying the four sides of a square court, and containing one of the largest and the best collection of paintings in Italy.

The Colonna palace has the finest gallery, and the best collection of pictures in Rome. The exterior of the building is of indifferent architecture. The library is spacious and well filled, and its great gallery, more than 220 feet long, and 40 broad, is supported by Corinthian pillars and pilasters of beautiful yellow marble, and adorned on the sides and vaulted ceilings with paintings and gildings intermingled.

A part of the paintings and curiosities of the Palazzo Barberini have been sold, from the poverty of the family. Another part of them at the Lucanni palace form a very select collection.

The Palazzo Borghese, one of the largest and handsomest in Rome, is now inhabited by Paolina, the sister of Bonaparte and the wife of the prince Borghese, who lives constantly at Florence. The edifice is superb, and remarkable for its extent, its porticos, its granite columns, and its paintings and statues.

The other leading palaces in Rome are the P. Ruspoli, remarkable for its staircase; the P. Orsini, founded on the theatre of Marcellus; the P. Giustiniani, standing near Nero's baths, and adorned with the statues and columns extracted from them; the P. Altieri, adorned with the pictures of Claude Lorraine; the P. Corsini, once the residence of Christina, queen of Sweden, remarkable for its fine library and collection of prints; the P. Farnese, of immense size and elevation, and considered by some as the finest in Rome; the P. Falconieri, the residence of Cardinal Fesch; the P. Spada, containing the celebrated statue of Pompey, at the foot of which Cæsar fell.

The display of the luminous cross.

Among the curiosities which delight strangers at Rome, there are two exhibitions which require to be noticed, viz. the exhibition of the luminous cross in St. Peter's on the night of Good Friday, and the illumination of the dome of St. Peter's with the fire works which are displayed at the anniversary of the festival of St. Peter. On the night of Good Friday the 100 lamps, that burn over the tomb of the apostle, are extinguished, and a stupendous cross of light appears, suspended from the dome between the altar and the nave. This exhibition is said to have been invented by Michael Angelo. "The magnitude of the cross," says Eustace, "hanging as if self-supported, and like a vast meteor streaming in the air—the blaze that it pours forth—the mixture of light and shade cast on the pillars, arches, statues and altars—the crowd of spectators placed in all the different attitudes of curiosity, wonder, and devotion—the processions with their banners and crosses gliding successively along the nave, and kneeling around the altar, the penitents of all nations and dresses collected in groups near the confessional of their respective languages; a cardinal occasionally advancing through the crowd, and as he kneels, humbly bending his head to the pavement; in fine, the pontiff himself, without pomp or pageantry, prostrate before the altar, offering up his adorations in silence, forms a scene singularly striking, by a happy mixture of tranquillity and animation, darkness and light, simplicity and majesty." The illumination of St. Peter and the Girandola, and fireworks from the castle of St. Angelo, which mark the festival of St. Peter, are allowed by all classes of spectators to be one of the grandest sights that the eye can witness. "The whole of this immense church," says the author of *Rome in the Nineteenth Century*, "its columns, capitols, cornices, and pediments, the beautiful swell of the lofty dome towering into heaven, the ribs converging to one point at top, surmounted by the lantern of the church and crowned by the cross, all were designed in lines of fire, and the vast sweep of the circling colonnades in every rib, line, mould, cornice, and column, were resplendent in the same beautiful light. While we were gazing on it, suddenly a bell chimed, and the cross of fire at the top waved a brilliant light as if wielded by some celestial hand, and instantly 10,000 globes and stars of vivid fire seemed to roll spontaneously along the building as if by magic, and self-kindled, it blazed in a moment into a dazzling flood of glory. Viewed from the Querita de Monti it seemed to be an enchanted palace hung in air, and called up by the wand of some invisible spirit. The fireworks from the castle of St. Angelo commenced by a tremendous explosion, that represented the raging eruption of a volcano. Red sheets of fire seemed to blaze upwards into the glowing heavens, and then to pour down their liquid streams upon the earth. Hundreds of immense wheels turned round, letting fall thousands of hissing dragons, and scorpions, and fiery snakes. Fountains and jets of fire threw up their blazing cascades into the skies, and the whole ended in a tremendous burst of fire, that, while it lasted, almost seemed to threaten conflagration to the world." The expence of the illumination is 1000 crowns when repeated on two successive evenings, and 700 when exhibited once. Eighty men are employed in the instantaneous illumination of the lamps.

The population of Rome, in the spring of 1821, amounted to 135,171 souls, and at the same season in 1822 it amounted to 136,085, being an increase of 914 persons.

For the preceding description of modern Rome, we have been indebted principally to Eustace's *Tour through Italy*, Lond. 1813, vol. i.; and to *Rome in the Nineteenth Century*, Edin. 1820.

Romé de l'Isle.

ROME' DE L'ISLE, JOHN BAPTIST LOUIS, a celebrated French crystallographer, was born at Gray, in Franche-Comté, in 1736. At a very early period of his life he went to India, as secretary to a corps of engineers. The period of his return is not known, but in 1757 he went a second time to the east, was taken prisoner at Pondicherry, and finally returned to Europe in 1764, after a captivity of five years endurance. In 1766 he published a "Letter to M. Bertrand, on Fresh Water Polypes," in which he considered the polypus as a tube for the reception of an infinity of small isolated animals. Having begun the study of natural history, along with Le Sage, he directed his particular attention to mineralogy. His first work was a Catalogue

Romney, George.

Raisonnée of M. Davila's collection, intended for sale, which appeared in 1767, in three volumes 8vo.; and he was thus led to an accurate examination of the forms of crystallized bodies, and to the construction of a system of crystallography. His first essay on crystallography was published in 1771, and contains 110 species of crystals, of which Linnæus knew only about 40. His fame was rapidly extended by this production. Linnæus courted his correspondence, and he was honoured with a seat in many of the academies of Europe. His countrymen, hovever, were the last to appreciate his talents, and from the circumstance of his having published eight explanatory catalogues of collections from 1767 till 1782, they were disposed to regard him more as a scientific drudge than as a philosopher. In 1778 he published an explanation of Le Sage's theory of chemistry, and in 1779 appeared his work entitled *L'Action de Feu central, banni de la Surface du Globe, et le Soleil rétabli dans ses droits.* His first work, however, by which he will be long remembered, was published in 1783, under the title of *Crystallographie; ou Description des Formes propres de tous les Corps du Regne Minérale,* in four volumes octavo.

Besides the works now mentioned he published *Caractères Extérieures des Minéraux,* in 1787, and in 1789, *Métrologie; ou Tables pour servir à l'Intelligence des Poids et des Mésures des Anciens, d'apres leur rapport avec les Poids et les Mésures de la France.*

Some time before his death, the eyes of our author failed him, and he died of a dropsy at Paris, on the 10th March, 1790.

The great merits of Romé de l'Isle in mineralogy are less generally acknowledged than they deserve; particularly by the French mineralogists. Modern mineralogists are often astonished at the accuracy of the descriptions given by this author, even of such substances as were afterwards confounded with each other by Haüy and those who copied him. In almost every page the power of observation is displayed in a remarkable degree, joined with good sense, correct reasoning, and a vast mineralogical erudition. His figures of crystals, indeed, are frequently far from affording the pleasing effect of geometrical perfection, which captivates the eye in the figures adorning the great work of Haüy; yet they betray the hand of the master, who seized the peculiar character of the individual crystals which he represents, and which is often better preserved in these sketches than in better executed drawings.

The student will always find a great deal of instruction in perusing the second edition of his *Crystallographie,* the result of more than twenty years continued and well-directed exertions; but those who are already proficient in the science will find pleasure in discovering in his writings that they have often been anticipated in their descriptions. It may be said with perfect propriety, that, however ingenious the views of Haüy may have been in regard to the property of cleavage, he could never have succeeded in establishing them as a general system, applicable to all crystallized minerals, had he not possessed the observations and drawings of Romé de l'Isle. This great man met with all the opposition commonly incidental to new ideas, or to a degree of accuracy which, in fact, is far beyond what had been customary before; but the prejudices had worn off, when Haüy's system appeared, which then earned the rewards both of its own merits and of Romé de l'Isle's. Haüy has always been candid enough to acknowledge every thing he owed to the latter; he supplied the link which made Romé de l'Isle's observations useful, by introducing general views in crystallography, founded upon geometrical processes, and by giving a particular name to every substance determined as a particular species. Romé de l'Isle was particularly regardless of the two great points, which, according to Linnæus, like the thread of Ariadne, lead us through the maze of the variety of nature,—the systematic disposition and denomination of the species; although, in his paper *Des Caractères Extérieures des Minéraux,* he has given principles for the determination of the latter, independent of chemical analysis, which will stand every attack, and remain one of the most valuable disquisitions on the subject ever proposed to the public, and which ought to be studied by every one who wishes to inform himself on this important subject. Romé de l'Isle was the first to vindicate mineralogy to the province of natural history; against the pretensions of chemists, who, even at that time, when chemical knowledge, particularly of minerals, was so imperfect, undervalued every thing that was constant in minerals. This may account, in a great measure, together with the neglect of those parts which have been afterwards so highly improved by Haüy, why Romé de l'Isle's works have never had that degree of influence to which they were entitled by their excellence.

ROMNEY, George, a celebrated English painter was born at Dalton in Lancashire, on the 26th of December 1734. At the age of twelve he was taken from school to superintend the workmen of his father, who was a builder and a farmer; and in his leisure hours he amused himself with carving, and in making a violin and other articles. The sight of some engravings in a magazine turned his attention to drawing, and he was put under an artist of the name of Steele, who instructed him in the rudiments of the art. He soon began portrait painting as a profession; and when he had realized one hundred guineas, he took thirty along with him, and leaving the rest with his wife, he set out for London, where he arrived in 1762.

He began his career by painting portraits at five guineas a head. In 1764 he went to Paris, where he studied the works of art in that capital. Upon his return to England, he obtained considerable employment in his profession, and in 1765 he got the prize from the Society of Arts for his historical picture of the death of King Edmund.

Conscious of the necessity of improving his style by the study of the ancient masters, he left an income of L.1200 per annum, and in 1773 he set out for Rome, and spent two years in the study of his art. He returned to London in 1775, where he devoted himself to portrait painting. He had leisure, however, to execute several historical pictures, among which may be enumerated, "Ophelia," "Titania and her Indian Votaress," "Titania, Puck, and the Changeling," "the Storm, from the *Tempest,*" the Cassandra, from *Troilus and Cressida,*" and "the Infant Shakspeare, from the Boydell Gallery." He also executed some large cartoons in charcoal, among which was one of the Dream of Atossa.

In the year 1785 he painted portraits to the value of L.3635.

In 1790 he again visited Paris with his friend Mr. Hayley, and on his return in 1791, he resumed the labours which he had some time before begun for the Shakspeare Gallery, and painted some pictures for the Prince of Wales.

In 1798, our artist retired from his profession to

Romney, Romsey.

a house which he had built at Hampstead; but finding that his health declined, he revisited his native county in 1799, and at Kendal, where he took up his residence, he died in November 1802, in the sixty-eighth year of his age.

ROMNEY, a town of England in Kent, and one of the cinque ports, stands on high ground in the centre of Romney Marsh. It consists principally of a broad well-paved street, crossed by another, in which stands the brotherhood house, where the mayors, &c. of the Cinque Ports formerly assembled. The market house, which is a modern edifice, is situated in the principal street. The church of St. Nicholas, which is ancient, contains a great variety of monuments. It has three aisles and three chancels, and at its west end, a square tower. Romney returns two members to parliament. Old Romney, about two miles from New Romney, consists only of about twenty houses and a church. Near the road from Dymchurch towards Romney, extensive ranges of barracks for infantry and cavalry, were erected about the end of the last war. Population of New Romney, 850. See the *Beauties of England and Wales*, Vol. VIII. p. 1142.

ROMNEY MARSH. See Kent, Vol. XII. p. 438.

ROMSEY, a market town in Hampshire, is situated on the river Test or Anton, between Salisbury and Southampton. The principal public buildings are the audit-house, which is a large square building, supported by pillars, and standing near the centre of the town: the town-hall, which is a small old building; the abbey church and presbyterian meeting-house. The church is an interesting and spacious Gothic building, in the form of a cross, consisting of a nave, aisles, a north and south transept, a choir or chancel with aisles, three small chapels or oratories at the east end, two small semicircular chapels at the angles of the transepts, with the choir, and a low tower rising on four lofty arches. On the outer wall of the south transept, is a remarkable bas-relief of our Saviour on the cross, near which is a square hole or recess in the wall, the use of which is not known. At a little distance, a finely ornamented Saxon arch connects the church and cloisters. Marks of cannon balls, said to have been fired during the civil wars, are seen on the outside of the north transept. A very particular account of this church, by Dr. Latham, will be found in the *Archæologia*. The corporation consists of a mayor, recorder, six aldermen, and twelve burgesses. The town is surrounded by pleasant meadows, which irrigation, by means of the rivers, has rendered very productive.

There was formerly a considerable clothing trade carried on here, but it has almost wholly declined; and the operative inhabitants are employed in some paper works, and a manufactory of sacking. They carry on also some trade in beer, and there are some corn mills in the vicinity. Sir William Petty was born here in 1623.

In 1821, the population of the entire parish of Romsey, including Romsey extra and infra, was 5128, of which the families employed in trade were 532. See *The Beauties of England and Wales*, Vol. VI. p. 224; and the *Archæologia*, Vols. XIV. and XV.

RONA, North, a small island in the Northern Sea, about sixteen leagues N. W. of the Butt of Lewes, and considered as the most north-western point of Europe. Dr. MacCulloch found that it was thirteen miles farther to the north than it is laid down in the maps. It is somewhat more than a mile long, and about half a mile broad at the widest. The southern cliffs are from thirty to sixty feet high; but on the north, they rise to 500, and contain an immense cave, with a wide aperture, and probably of a considerable depth, as it appeared to Dr. MacCulloch as black as night. On the west angle of the island, the sea commits terrible ravages. From the angles, the land rises with a gentle and even swell towards the north and east. It is covered with a compact turf, excepting a few cultivated acres in the middle.

The island is inhabited by one family, who cultivate about six or seven acres, and feed fifty sheep. The fuel used is turf; and water is obtained from holes in the rocks. The farmer's house is an excavation covered with turf and straw. Dr. MacCulloch has given a long account of his visit to this island in his *Highlands and Western Isles of Scotland*, Vol. III. p. 301—323.

RONA, or Ronay, an island of Scotland in the Hebrides, lying between the mainland and the Isle of Sky. It is about five miles long and one broad, forming a sort of high irregular ridge, and separated from Rasay, to which it belongs, by a strait barely navigable, and containing the small island of Maltey and some islets. "Among the rifts and intervals, says Dr. MacCulloch, scarcely worth the name of valleys, there are found patches of beautiful green pasture, and now and then the black hut of some small tenant. The little arable ground which occurs in Rona, surrounds the scattered village that lies at the bottom of the bay of Archasig Hirm, which contains all the population of the island." This bay, which is about the middle of the island, has deep water and clear ground, and is perfectly land-locked, with a double entrance. The surface of the island is tolerably level, and the soil fertile. There are numerous caves on its rocky coasts, some of which contain fine stalactites. See Macdonald's *Agricultural Survey of the Hebrides*, p. 774; and Dr. MacCulloch's *Highlands and Western Isles of Scotland*, Vol. III. p. 380.

RONALDSHEY, North, or Ronald's Island. See Orkney Islands, Vol. XVI. p. 8.

RONALDSHEY, South. See Orkney Islands, Vol. XVI. p. 6.

ROOF.

Roof.

ROOF is the name given to the covering of a house or building of any kind, of whatever materials the roof is composed; but in carpentry, it is limited to the timber work or framing by which the external covering of the roof is supported.

In our article on the theory of Carpentry, we have already treated, in a popular manner, of the resistance of beams to cross strains, whether the straining forces act perpendicularly, or obliquely to the length of the beams, and whether the beams are supported at one or both ends; and in our article on practical carpentry, is given a great deal of practical information on the subject of roofing in general; on circular, elliptical, and polygonal roofs; on the covering of circular roofs; on trusses or framings of carpentry; with the dimensions and representations of some of the most celebrated roofs that have been constructed.

In the present brief article, we purpose to treat very generally of the equilibrium of a framing of timber or an assemblage of beams; and to add a notice of some roofs and framings which have not been given in the preceding part of the work.

When the distance between two walls, or the width of a river is too great to be crossed by a single beam, the desired effect may be produced by an assemblage of two or more pieces of wood or beams.

1. The simplest form of a roof is when two beams are used, as in Plate CCCCLXXXI. Fig. 1, where A C is the distance to be crossed; and AB, BC, the two beams employed for this purpose, either to carry a roof or the roadway of a bridge. The first question for our consideration here is, the pitch or declivity of the roof or the angle ABC. We have already shown under Carpentry, p. 506, that two beams, AB, AD will bear the same load, being both equal to a horizontal beam AE. If a beam AD, therefore, is just able to carry the roofing which it is to bear, the more inclined beam AB, having to support a greater quantity of roofing from its greater length, will require to be stronger than AD. Hence steeper roofs must always require stronger beams, or the same beams to be placed closer to each other in the proportion of their greater length; or the depth of the beam AB must be to that of AD as the square root of AB is to the square root of AD.

In this construction of a roof, it is obvious that the walls or abutments at A and C are supposed capable of sustaining the joists at A and C, pressing them outwards; but as the ordinary walls of houses are quite unfit to resist any such force, it becomes necessary to resist it by another of sufficient power. This effect is obtained by introducing the beam AC, which is called a *tie*, from its binding together the feet A and C, of the two inclined beams AB, CB. The whole weight of the roof, therefore, in place of pushing out the walls, is exerted in drawing out or stretching the tie-beam AC in the direction of its length. If we consider this tie-beam merely as a part of the roof, its place might be supplied by a chain, or wire, or rope of equal strength; but as it is often used to carry the weight of the ceiling of the room below it, and sometimes to carry a flooring, it is generally made strong and connected with the feet A and C of the rafter by a mortice and tenon.

When the tie-beam AC is long, it has a tendency to bend down or sway at its middle E. It therefore requires to be sustained at that part, and this is effected by suspending it by a short beam BE, from the ridge B. This beam BE, is called the *king post*, and performs the part of a string or chain. The various methods of joining the king posts or rafters, &c. has already been explained under Carpentry, Vol. V. p. 537, and in Plate CXXVIII. Fig. 4, &c.

When the rafters AB, BC are long, or considerably loaded, they also have a tendency to bend. In order to prevent this, *braces* or *struts* EF, EG are morticed into them at C and F, and also into joggles at the foot of the king post. By this means, the rafters have their relative strength quadrupled, in consequence of being reduced to half their original length.

Having thus explained the construction of roofs, consisting of two principal rafters, we shall proceed to the consideration of those of a more complicated form, where the rafters are more than two in number; in which case it is generally called a kirb roof.

We have already demonstrated in our article Bridge, Vol. IV. p. 490, that if a string or festoon of heavy bodies connected together, is suspended from its two extremities, (See Plate LXXX. Fig. 2.) they will arrange themselves into a Catenarian curve by the force of gravity; and that if this assemblage of bodies is inverted so as to rest upon the former points of suspension, it will form an arch of equilibration. The same is obviously true of any number of bars of metal or beams of wood, connected together by moveable joints, so as to take the position of equilibrium, which the force of gravity acting upon each of the beams must necessarily give them.

The slightest consideration is sufficient to convince us that such a position of the beams is that which they should have when formed into a roof. In this position, all the rafters are in equilibrium with each other, and are acting on each other in the direction of their lengths, and consequently resisting any external and uniformly distributed strains acting in the direction of gravity with the greatest force.

Fig. 5. In Fig. 5, for example, let AB, BC, CD, DE, be rafters moving round flexible joints, and arranging themselves in the curve of equilibrium ABCDE; this is the position which must be given them when fixed into a kirbed roof, with this difference only, that they must be placed in an inverted position.

If they have any other position different from that of equilibrium, such as is shown by the dotted lines in Fig. 5, where *Ab*, *bc*, *cd*, *dE*, are the rafters, then the rafter *cd* must be held in its depressed position by some external force; and, consequently, when the whole is inverted to form a roof, the rafter *cd* must have a tendency to assume the position of equilibrium CD, and in consequence of this unbalanced force *cd*, and all the other beams will not act upon each other in the direction of their lengths, and consequently will not be in their strongest position. When they are placed, on the other hand, in a position of equilibrium, the tie-beam, the king post, and the braces, &c. have to perform no other office but that of preserving the rafters in their position of equilibrium.

If the strain is uniformly diffused over the roof, as in houses covered with slate or lead, or if unequal loads are symmetrically placed upon it, then the form of the roof, or the curve of equilibrium will be symmetrical, and its two halves will be equal and similar; but if it is loaded more in one place than another, and if that place is not on the ridge, then the form of the rafters must be unsymmetrical. Thus in Fig. 5, if the rafters AB, BC, CD, DE, are made equally heavy, the curve will be as in the figure; and is symmetrical, the angle ABC being equal to the angle CDE. If BC and CD, made equally heavy, are heavier than AB and DE, which are equally heavy, then BC and CD will fall lower, increasing the angles ABC and CDE, and diminishing the angle BCD; but still the curve passing through the joints, will be symmetrical. If the part of the roof CD is to be loaded with lead, while all the rest is to carry only slating, then CD being much heavier than any of the other rafters, will sink in the experiment of suspension to *cd*, raising the joint B to *b*, and depressing C to *c*, and D to *d*. The form of the roof will therefore be that of A*bcd*E, which is no longer symmetrical.

Although it is now easy for the practical mechanic to determine experimentally the position of the rafters of a kirb roof mechanically, by loading the centres of gravity of his experimental beams, in the same manner as the corresponding beams in the roof are to be loaded; yet it is desirable to have a mathematical method of determining the best form of a kirb roof.

By referring to our article Bridge, Vol. IV. p. 490, and to Plate LXXX. *Fig.* 4, where the rafters are represented as cords, it will be found to be demonstrated,

1. That the tension in any part of the cord is inversely as the sine of its inclination to the vertical, and

2. That the loads on the different joints (C, C′, C″)

or the tension produced by the weights w, w', w'', are directly as the sines of the angles at these joints; and inversely as the products of the sines of the angles which the rafters make with a vertical *line*, that is, in Fig. 4, Plate LXXX.

$$\text{Tension } d\,c \text{ is as } \frac{\text{Sin. } r\,C\,l}{\text{Sin. } r\,C\,d \times \text{Sin. } d\,C\,l}$$

with these data, we are now prepared to determine the best form of a kirb roof.

Method of finding the best form of a kirb roof. Plate CCCCLXXXI. Fig. 6.

Let it be required to find the form of a kirb roof ABCDE, whose rafters AB, BC, CD, DE are equal, AE being the width, and CF the height of the roof. As the points A, C, and E, are fixed, this problem resolves itself into finding the position of the point D, in the line DHG, bisecting CE perpendicularly, when the loads at the angles C and D are equal, and consequently in equilibrio.

From the point G, where DH intersects AE, and with the radius GE describe the circle EKC, passing through C, because CH bisects CE at right angles. Draw HK, parallel to FE, cutting the circle EC in K, and join KC. The point D, where CK cuts GH, produced is the point required, and the lines CD, ED, meeting at this point, show the position of the rafters.

Produce ED till it cut the vertical bar FC in N, and having given the rafters CB, BD, the same position as CD, DF, complete the parallelogram BCDP, and draw DB, bisecting CP in R. Join K, F by the line KF, which is parallel to DP, because CDP=CKF, on account of the parallelism of RD, QK, and the equality of CR, RP and CQ, QF; make CS equal and parallel to FG, and upon S with the radius SF, describe the semicircle WKF, which must pass through K, because CG=SF=GE and CQ=QF. Join WK and WS, and produce BC cutting ND in O. Now the angle WKF, at the circumference, is equal to WSF at the centre, and is therefore equal to WSC or CGF, and double of CFE, or its alternate angle ECS. But ECS=ECD+DCS, and ECD=½NDC and DCS=½DCO, or the alternate angle CDP. Hence WKF=NDC+CDP=NDF, and WK parallel to ND. Consequently CF : CW = CP : CN; and hence CF = CW we have CN = CP.

Now, in the two triangles CDN, CDP, the sides are to one another as the sines of the opposite angles, as follows.

$$\begin{aligned} CN : CD &= \text{Sin. } CDN : \text{Sin. } CND \\ CD : DP &= \text{Sin. } CPD : \text{Sin. } CDP \\ DP : CP &= \text{Sin. } PCD : \text{Sin. } CDP \end{aligned}$$

Hence

$CN : CP = \text{Sin. } CDN \times \text{Sin. } CPD \times \text{Sin. } PCD :: \text{Sin. } CND \times \text{Sin. } PCD \times \text{Sin. } CDP$, or

$$CN:CP = \frac{\text{Sin. } CDN}{\text{Sin. } CND \times \text{Sin. } PCD} : \frac{\text{Sin. } CDP}{\text{Sin. } PCD \times \text{Sin. } CPD}.$$

But CDN, CDP, are the angles at the joints and CND, PCD, and PCD, CPD, are the angles which the rafters make with the plumb lines, consequently CN is to CP, directly as the sines of the angles at the joints, and inversely as the products of the sines of the angles which the rafters make with the vertical; that is, CN : CP as the loads at the joints D and C; but CN = CP, consequently the loads at the joints are equal, and the rafters being equal, they will be in equilibrio.

When the rafters CD, DE have any other proportion than that of equality, as for example ED′, D′C, the point D will be in the circumference of a circle H′D′*k*′, having its centre in the line CE, and ED′ : D′C = CH : HE′ = *c k*′ : *k*′E.

When a roof requires to be flat on the top, it may be considered as consisting of three rafters A B, B C, C D, Fig. 7. If B C is horizontal and A B, D C, equally inclined to it, it is obvious that the rafters will be in equilibrio. In order to stiffen this roof, *queen posts* B E, C F, are placed at the angles B, C, and are connected with the tie-beam A D either by mortices or straps. This form of roof though less strong than A G D would have been, of the same scantling, yet it has the advantage of giving more room for garrets. A stronger but less commodious form is shown in Fig. 8.

In the construction of roofs of all kinds, those parts which compose it may be divided into two kinds, viz. those which are compressed and require stiffness as well as cohesion, such as rafters, braces, and trusses, and those which are extended only, as tie-beams, king posts and queen posts, and which may be replaced by ropes, chains, or rods of iron. All pieces of timber in a roof, excepting the sarking, ought to perform one or other of these offices, and ought either to be pushed or stretched in the direction of its length.

As the limits assigned to this article will not permit us to enter into any farther theoretical details on this subject, we shall now communicate for the benefit of the practical mechanic, some useful information on the subject of roofs, for which we are indebted to Mr. Tredgold's excellent work on the elementary principles of carpentry.

The general height of roofs varies between one-third and one-sixth of the span. For slates the usual height is one-fourth, which make the inclination to the horizon 26½ degrees.

The following table, given by Mr. Tredgold, shows the inclination that may be given for other materials.

	Inclination to the Horizon.	Height of Roof, or part of Span.	Weight of a square of Roofing.
Copper or Lead	3° 50′	1/48	Copper 100 Lead 700
Slates large	22 0	1/5	1120
Slates ordinary	26 33	1/4	From 900 to 500
Stone Slate	29 41	2/7	2380
Plain Tiles	29 41	2/7	1780
Stone Tiles	24 0	2/9	650
Thatch of Straw, Reeds or Heath	45 0	1/2	

The following tables of the scantlings and timbers for roofs of different spans from 20 to 30 feet; from 32 to 46 feet; from 48 to 60 feet, and from 65 to 90.

In these tables the pitch of the roof is supposed to be about 27°, the covering slate, and the timber good Riga or Memel fir. When the timber is soft, spongy, or inferior in any way, it will require to be of larger dimensions. One-fourth of an inch in each dimension will be sufficient to compensate for any difference in quality, unless in the case of knotty timber.

Table I. See Plate CCCCLXXXI. Fig. 9.

Span.	The Beam A.	King Post K.	Principal Rafters P.	Braces B.	Purlins C.	Small Rafters r.
Feet.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
20	9½ by 4	4 by 3	4 by 4	3½ by 2	8 by 4¾	3½ by 2
22	9¾ by 5	5 by 3	5 by 3	3¾ by 2¼	8¼ by 5	3¾ by 2
24	10½ by 5	5 by 3½	5 by 3½	4 by 2½	8½ by 5	4 by 2
26	11½ by 5	5 by 4	5 by 4¼	4¼ by 2½	8¾ by 5	4¼ by 2
28	11½ by 6	6 by 4	6 by 3½	4½ by 2¾	8¾ by 5¼	4½ by 2
30	12½ by 6	6 by 4½	6 by 4	4¾ by 3	9 by 5½	4¾ by 2

The trusses are supposed in this table not to be more than 10 feet apart.

Fig. 9. is drawn with a parapet wall on one side, and with eaves on the other.

Table II. Plate CCCCLXXXI. Fig. 10.

Span.	Tie-beam A.	Queen Posts Q.	Principal Rafters P.	Straining Beam S.	Braces B.	Purlins C.	Small Rafters r.
Feet.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
32	10 by 4½	4½ by 4	5 by 4½	6¾ by 4½	3¾ by 2½	8 by 4¾	3½ by 2
34	10 by 5	5 by 3½	5 by 5	6¾ by 5	4 by 2½	8½ by 5	3¾ by 2
36	10½ by 5	5 by 4	5 by 5¼	7 by 5	4½ by 2½	8½ by 5	4 by 2
38	10 by 6	6 by 3¾	6 by 6	7½ by 6	4½ by 2½	8½ by 5	4 by 2
40	11 by 6	6 by 4	6 by 6	8 by 6	4½ by 2½	8¾ by 5	4½ by 2
42	11½ by 6	6 by 4½	6½ by 6	8½ by 6	4½ by 2¾	8¾ by 5¼	4½ by 2
44	12 by 6	6 by 5	6½ by 6	8½ by 6	4½ by 3	9 by 5	4¾ by 2
46	12½ by 6	6 by 5½	7 by 6	9 by 6	4¾ by 3	9 by 5½	5 by 2

Fig. 10.

In the roof represented in Fig. 10, the principal rafters P are exposed to no cross strains as each purlin C is supported; and the points of support divide the tie-beam into three bearings comparatively short.

At the side marked D of the figure, and above D, the end of the principal rafter P is made to abut against the end of the straining beam S, from being notched and bolted together in pairs at each joint. By this means the sagging is avoided which generally arises from the sinking of the heads of the queen posts.

Table III. Plate CCCCLXXXI. Fig. 11.

Fig. 11.

Span.	Tie-beam A	Queen Posts Q.	Posts D.	Principal Rafters P.	Straining Beam S.	Braces B.	Purlins C,	Small Rafters r.
Feet.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
48	11½ by 6	6 by 5¾	6 by 2¼	7½ by 6	8¼ by 6	4½ by 2¾	8½ by 5	4 by 2
50	12 by 6	6 by 6¼	6 by 2½	8½ by 6	8½ by 6	4½ by 2¾	8¾ by 5	4¼ by 2
52	12 by 6½	6 by 6¾	6 by 2¾	9¼ by 6	8¾ by 6	4¾ by 2¾	8¾ by 5¼	4¼ by 2
54	12 by 7	7 by 6½	7 by 2½	6¼ by 7	9 by 6	4¾ by 2¾	8¾ by 5¼	4½ by 2
56	12 by 8	7 by 6¾	7 by 2½	7½ by 7	9¼ by 6	5 by 2½	8¾ by 5¼	4½ by 2
58	12 by 8½	7 by 7¼	7 by 2¾	8¼ by 7	9½ by 7	5 by 2¾	9 by 5¼	4¾ by 2
60	12 by 9	7½ by 7	7 by 3	9 by 7	10 by 7	5 by 3	9 by 5½	4¾ by 2

The roof shown in Fig. 11 has the advantage of leaving much free space in the middle. For spans of this width, the tie-beam should be scarfed between *a* and *b*. The middle of the tie-beam may be strengthened by bolting to it the straining sill *s*.

Table IV. Plate CCCCLXXXI. Fig. 12.

Fig. 12.

Span.	Tie-Beam A.	Queen Posts Q.	Posts D, D.	Principal Rafters, P.	Straining Beam S.	King Post K.	Braces B.	Purlins C.	Small Rafters r.
Feet.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
65	15 by 10½	8 by 7	5 by 3	8 by 7½	10½ by 8	5 by 3	5 by 3½	8¼ by 5	4 by 2
70	15 by 11¾	9 by 6½	5 by 3½	9 by 7	10½ by 9	5 by 3½	5 by 3¾	8½ by 5	4½ by 2
75	15 by 13¾	9 by 7½	5 by 4	9 by 8	11¼ by 9	5 by 4	5 by 4½	8¾ by 5	4½ by 2
80	16 by 13	9 by 9	6 by 4	10½ by 9	12 by 9	6 by 4	6 by 3½	8¾ by 5¼	4½ by 2
85	16 by 13½	9½ by 9	6 by 4½	12 by 9	12¾ by 9	6 by 4½	6 by 4	9 by 5¼	4¾ by 2
90	16 by 14	10 by 9¾	6 by 4½	10½ by 10	13 by 10	6 by 4½	6 by 4	9 by 5½	5 by 2

In the roof shown in Fig. 12, the straining sill *s* should be tabled or keyed, and should be bolted to the tie-beam in the manner represented in Plate CXXVII. of Carpentry, Fig. 2, No. 2, and described in p. 534. This roof resembles that of the Birmingham theatre, described with the scantlings and timbers, in Nicholson's *Carpenter's Assistant*, p. 61, Plate 73, 2d Edition.

Table V. Plate CCCCLXXXI. Fig. 13.

Span.	Tie-Beam.	Curved Rib.	Suspending Pieces.		Purlins.	Common Rafters.
			No. pairs.	Scantlings of each piece.		
Feet.	Inches.	Inches.		Inches.	Inches.	Inches.
20	8 by 4	4 by 4	3	4 by 2	8 by 5	3½ by 2
24	8 by 4	4¾ by 4	3	4 by 2	8 by 5	4 by 2
28	8 by 5	5½ by 5	3	4 by 2¼	8½ by 5	4½ by 2
30	8½ by 5	6 by 5	3	4 by 2¼	8½ by 5	4¾ by 2
32	9 by 5½	6 by 5½	3	4 by 2½	8½ by 5	5 by 2

In this roof the trusses are ten feet apart, and the pitch is the same as in the preceding table.

By reducing the upper part of the roof to the same form as in Fig. 11, it would answer for a span of from 60 to 75 feet, the scantlings being as in the above table. The roof, however, exhibits too great an expanse, and it is not easy to light the large space in it. Under these circumstances, an M roof is preferable. See Table VI.

Table VI. Scantlings for M Roofs. Plate CCCCLXXXI. Fig. 14.

Fig. 14.

Span.	Tie-Beam A.	Queen Post Q.	Principal Rafters P.	Straining Beam S.	Posts D.	Braces B.
Feet.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
55	12 by 8	8 by 6	8 by 8	10 by 8	6 by 4	6 by 4
60	12 by 9	9 by 6	9 by 7	10 by 9	6 by 4½	6 by 4½
65	13 by 9½	9½ by 6½	9½ by 8	11 by 9½	6 by 5	6 by 5

This roof is from Price's *British Carpenter*, and the scantlings from Mr. Tredgold's work. Mr. Tredgold remarks, that it would be better to make the top flat, and cover it with lead, and adopt the truss in Fig. 12, as the space gained in the roof would amply repay the cost of the lead.

We shall now conclude this article with a brief description of three very ingenious roofs by foreign carpenters, all of which have been described by Rondelet in his *L'art de Batir*, and also by Mr. Tredgold.

1. *Roof of the Basilica of St. Paul at Rome.*

PLATE CCCCLXXXI. Fig. 15.

The space which this roof crosses is 78.4 feet, and it is executed in fir. The trusses represented in Plate CCCCLXXXI. Fig. 15, are double, each consisting of two similar frames, placed 14.9 inches apart. The principal rafters, *p*, *p*, abut against a short king post, *k*. A piece of timber, *s*, is placed between the trusses, and is sustained by a strong key of wood passing through it and the short king posts. This piece, *s*, sustains the tie-beam, *t*, by a strong key at *a*. The tie-beams are in two lengths, and scarfed together by three iron straps. The following are the scantlings of the timber:

	Inches.		Inches.
The beams *t*,	22.5	by	14.9
Principal rafters *p*,	21.75	by	14.9
Auxiliary rafters *b*,	13.8	by	13.3
Straining beam C,	14.9	by	12.8

Parlins *d*, 8.5 square, and 5 feet 7 inches apart.
Common rafters, 5.3 by 4.25, and 8.5.

In this roof the common rafters are covered with strong tiles about 12 inches by 7, laid like pavement with mortar at the joints. Above this pavement a kind of plain tiles with ledges are laid, and the joints covered with crooked tiles. This roof is admired for its strength and simplicity of construction, and for the method of sustaining the middle of the tie-beam.

2. *Roof of the Theatre d'Argentina of Rome*, Fig. 16.

Fig. 16.

The opening which this roof covers, is 80½ feet, and its inclination is 24°. The tie-beam is composed of three pieces, and the principal rafters of two pieces, these pieces being all scarfed and strapped together. The common rafters, whose distance is from 10 to 11 inches, supported by 12 purlins on each side, carry a heavy covering of tiles. The tie-beams are very judiciously supported by stirrups of iron, as shown in the figures. This roof is of fir, and supports the machinery of the theatre, besides the covering and ceilings.

3. *Roof of the Riding-house, built at Moscow by Paul I. in* 1790, Fig. 17.

Fig. 17.

This roof is the widest that has ever been constructed. The span was 235 feet, and its inclination 19°. The principal support of this enormous roof is a curved rib of timber, consisting of three ribs indented together, and strapped and bolted with iron. The tie-beam consisted of seven pieces, and the principal rafters and the tie-beams were sustained by vertical pieces notched to the main rib, the whole truss being stiffened with diagonal braces. This roof settled so much that it was proposed to add another curved rib in the position indicated by the dotted lines. The riding-house was 1920 feet long and 310 wide.

We shall now conclude this article with a list of several important and scientific roofs that have been executed in different parts of the world, with references to the works in which they are represented and explained. The examination of these roofs will be an interesting study for the young engineer, as well as for the carpenter.

List of several roofs that have been executed in different parts of Europe.

1. Roof of the Pantheon in Oxford street, burned down in 1792. Designed by Mr. James Wyatt. Art. CARPENTRY in this work, Vol. V. p. 537, Plate CXXVIII. Fig. 1.

2. Roof of St. Paul's church, Covent Garden. Designed by Mr. Hardwick in 1794. Art. CARPENTRY, p. 537, Plate CXXVIII. Fig. 2.

3. Roof of the royal Hospital of Greenwich. Designed by Mr. James Stewart. Art. CARPENTRY, p. 538, Plate CXXVII. Fig. 3.

4. Roof of Southampton Church. Designed by Mr. Reveley in 1797. Art. CARPENTRY, p. 538, Plate CXXIX. Fig. 4.

5. 6. 7. These roofs are designed by Mr. Peter Nicholson, and described under CARPENTRY, page 538, and Plate CXXIX. Fig. 1, 2, 3.

8. Roof of the old Halle au Blé at Paris. Designed by Moulinier. Article CARPENTRY, page 539, Plate CXXIX. Fig. 5.

9. Roof designed by Mr. Peter Nicholson, for a dome. Article CARPENTRY, page 539. Plate CXXIX. Fig. 6.

10. Roof of the dome of St. Paul's Cathedral, designed by Sir Christopher Wren. Article CARPENTRY, page 539, 540. Plate CXXIX. Fig. 7, 8, 9.

11. Roof of the Theatre of the University of Oxford, designed by Sir Christopher Wren. Dr. Robison's *Works*, art. ROOF.

12. Roof of the Caledonian or Equestrian Theatre in Edinburgh, in 1809. *Idem*, ibid.

13. Roof of the Birmingham Theatre. Nicholson's *Carpenter's Assistant*, p. 61, Plate 72.

14. Roof of Drury Lane Theatre. *Idem*, ibid. p. 60.

15. Roof of Westminster School. Smith's *Specimens of British Carpentry*, Plate VIII. and Tredgold's *Carpentry*, Plate IX. Fig. 64.

16. Roof of the Basilica of St. Paul at Rome, executed about four hundred years ago. Rondelet, *L'Art de Batir*, tome iv. p. 170. Tredgold's *Carpentry*, p. 85, and Plate X. Fig. 66; and Plate CCCCLXXXI. Fig. 15, of this article.

17. Roof of the Theatre d'Argentina at Rome. Rondelet, *L'Art de Batir*, tome iv. p. 220. Tredgold's *Carpentry*, p. 86, and Plate X. Fig. 69, and Plate CCCCLXXXI. Fig. 16.

18. The largest roof ever executed, being that of the Riding House at Moscow, erected by Paul I. in 1790. Krafft's *Recueil de Charpente*, part ii. No. 59. Rondelet's *L'Art de Batir*, tome iv. Plate CXVI. Tredgold's *Carpentry*, p. 87. Plate XI. Fig. 7. and Plate CCCCLXXXI. Fig. 17.

19. Roof of the Royal Military Chapel at Woolwich, designed by Mr. Tredgold. Tredgold's *Carpentry*, p. 75, 226, and Plate VIII. Fig. 57.

20. Roof of a dock for building ships under cover, 95 feet span. Designed by Mr. Seppings. This roof, Mr. Tredgold remarks, is a fine specimen of the best method of stiffening and connecting the parts, but its parts are not in equilibrio. Tredgold's *Carpentry*, p. 18, Plate III. Fig. 25.

See the articles BRIDGE, CARPENTRY, JOINERY, and STRENGTH OF MATERIALS, and the following works.

Couplet, *Mem. Acad. Par.* 1726, 1731. Emerson's *Mechanics, Fluxions, Algebra, and Miscellanies.* Dr. Robison's treatises on ROOF and CARPENTRY, in his

Roof.

System of Mechanical Philosophy. Dr. Young's *Lectures on Natural Philosophy.* Barlow's *Essay on the Strength of Timber.* Rondelet's *L'Art de Batir.* Krafft's *Recueil de Charpente.* Smith's *Carpenter's Companion.* Salimbene, *Mem. Soc. Ital.* tom. iv. p. 249. Price's *British Carpenter.* Mathurin Jousse *Art de la Charpenterie.* Nicholson's *Carpenter's Assistant.* Nicholson's *Carpenter's Guide;* and particularly Tredgold's *Elementary Principles of Carpentry,* Lond. 1820, a work of great merit and utility. A method of raising sunken roofs will be found in the *Transactions of the Society of Arts,* vol. xx. p. 374, by Mr. Woart.

ROO ROO

Rooke, Sir George, Roots.

ROOK. See Ornithology, Vol. XVI. p. 33.

ROOKE, Lawrence, a mathematician of considerable eminence, was born at Deptford, in Kent, in 1623. After receiving a good education at Eton school, he was sent, in 1639, to King's college, Cambridge, where he took his degrees. In 1650 he engaged apartments in Wadham college, Oxford, for the purpose of enjoying the society of Dr. Wilkins and Mr. Seth Ward. He afterwards became a fellow commoner of the college; and during his residence at Oxford, where he remained for several years, he assisted Mr. Boyle in his chemical and physical experiments. In the year 1652, Mr. Rooke was appointed professor of astronomy in Gresham college; and in 1657, he exchanged that chair for that of geometry. Mr. Rooke was one of those meritorious individuals, by whose exertions the Royal Society was established, though he did not live to see it flourishing under the royal charter. Among Mr. Rooke's friends and patrons was the Marquis of Dorchester, who frequently invited him to his seat at Highgate, and took him every Wednesday to the Royal Society meetings in Gresham college. In consequence of walking on a hot summer's day from Highgate to London, he caught a cold, of which he died in June, 1662, in the 40th year of his age. Mr. Rooke enjoyed very high reputation during his life time; but the writings which he has left behind him possess little value, and are not worthy of being enumerated. See Ward's *Lives of the Gresham Professors.*

ROOKE, Sir George, a celebrated naval commander, was born in 1650. His passion for the navy was so strong, that he entered the service as a volunteer; and having distinguished himself by his courage and attention to business, he soon obtained the post of lieutenant, from which he rose to that of captain before he was thirty years of age. In 1690, he was appointed rear-admiral of the blue; and in 1692, he obtained the rank of vice-admiral, and served in the famous battle of La Hogue.* On the day following the battle, he succeeded in burning twelve ships of the line, and a 56 gun frigate in La Hogue. In consequence of this service, the king settled upon him a pension of £1000 per annum. In 1693, he received the honour of knighthood, and was made vice-admiral of the red. In 1696, he received the chief command of the Channel fleet, and he held this situation till the peace of Ryswick, in 1697. He was elected member of parliament for Portsmouth, and appointed one of the lords of the admiralty. In parliament he voted principally with the Tories; and when the Whigs went so far as to press King William to remove him from the Admiralty, his Majesty resolutely replied, "I will not.—Sir George served me faithfully at sea, and I never will displace him for acting as he thinks most usefully for the service of his country in the House of Commons." In 1700, he commanded the fleet which bombarded Copenhagen. In 1701, he commanded the Channel fleet; and when Queen Anne ascended the throne, he was appointed, as vice-admiral of England, to the united English and Dutch fleet which went out against Cadiz. Although that expedition failed, yet Sir George had the good luck to learn, that 22 Spanish galleons, guarded by a French squadron, had arrived in the harbour of Vigo, and having sent fireships into the harbour, he destroyed the men of war and several galleons, and captured the rest. After performing some other services to his country, Sir George retired into private life, and spent the remainder of his days in Kent, where he died in 1708, in the 58th year of his age. See Campbell's *Lives of the Admirals.*

ROOTS. In our articles Algebra and Arithmetic, we have treated of the roots of equations and of numbers at sufficient length. It remains only to give under the present article a Table of the square and cube roots of numbers, which will be found of the greatest use in various calculations both in science and the arts. The Table is too simple to require farther explanation.

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* See our article Britain, Vol. IV. page 614.

Root.

Table of Square Roots and Cube Roots.

Number.	Square Roots.	Cube Roots.	Number.	Square Roots.	Square Roots.	Number.	Square Roots.	Cube Roots.
1	1.0000000	1.0000000	51	7.1414284	3.7084298	101	10.0498756	4.6570095
2	1.4142136	1.2599210	52	7.2111026	3.7325111	102	10.0995049	4.6723287
3	1.7320508	1.4422496	53	7.2801099	3.7562858	103	10.1488916	4.6875482
4	2.0000000	1.5874011	54	7.3484692	3.7797631	104	10.1980390	4.7026694
5	2.2360680	1.7099759	55	7.4161985	3.8029525	105	10.2469508	4.7176940
6	2.4494897	1.8171206	56	7.4833148	3.8258624	106	10 2956301	4.7326235
7	2.6457513	1.9129312	57	7.5498344	3.8485011	107	10.3440804	4.7474594
8	2.8284271	2.0000000	58	7.6157731	3.8708766	108	10.3923048	4.7622032
9	3.0000000	2.0800837	59	7.6811457	3.8929965	109	10.4403065	4.7768562
10	3.1622777	2.1544347	60	7.7459667	3.9148676	110	10.4880885	4.7914199
11	3.3166248	2.2239801	61	7.8102497	3.9364972	111	10.5356538	4.8058955
12	3.4641016	2.2894286	62	7.8740079	3.9578915	112	10.5830052	4.8202845
13	3.6055513	2.3513347	63	7.9372539	3.9790571	113	10.6301458	4.8345881
14	3.7416574	2.4101422	64	8.0000000	4.0000000	114	10.6770783	4.8488076
15	3.8729833	2.4662121	65	8.0622577	4.0207256	115	10.7238053	4.8629442
16	4.0000000	2.5198421	66	8.1240384	4.0412401	116	10.7703296	4.8769990
17	4.1231056	2.5712816	67	8.1853528	4.0615480	117	10.8166538	4.8909732
18	4.2426407	2.6207414	68	8.2462113	4.0816551	118	10.8627805	4.9048681
19	4.3588989	2.6684016	69	8.3066239	4.1015661	119	10.9087121	4.9196847
20	4.4721360	2.7144177	70	8.3666003	4.1212853	120	10.9544512	4.9324242
21	4.5825757	2.7589243	71	8.4261498	4.1408178	121	11.0000000	4.9460874
22	4.6904158	2.8020393	72	8.4852814	4.1601676	122	11.0453610	4.9596757
23	4.7958315	2.8438670	73	8.5440037	4.1793390	123	11.0905365	4 9731898
24	4.8989795	2.8844991	74	8.6023253	4.1983364	124	11.1355287	4.9866310
25	5.0000000	2 9240177	75	8.6602540	4.2171633	125	11.1803399	5.0000000
26	5.0990195	2.9624960	76	8.7177979	4.2358236	126	11.2249722	5.0132979
27	5.1961524	3.0000000	77	8.7749644	4.2543210	127	11.2694277	5.0265257
28	5.2915026	3.0365889	78	8.8317609	4.2726586	128	11.3137085	5.0396842
29	5.3851648	3.0723168	79	8.8881944	4.2908404	129	11.3578167	5.0527743
30	5.4772256	3.1072325	80	8.9442719	4.3088695	130	11.4017543	5.0657970
31	5.5677644	3.1413806	81	9.0000000	4.3267487	131	11.4455231	5.0787531
32	5.6568542	3.1748021	82	9.0553851	4.3444815	132	11.4891253	5.0916434
33	5.7445626	3.2075343	83	9.1104336	4.3620707	133	11.5325626	5.1044667
34	5.8309519	3.2396118	84	9.1651514	4.3795191	134	11.5758369	5 1172299
35	5.9160798	3.2710663	85	9.2195445	4.3968296	135	11.6189500	5.1299278
36	6.0000000	3.3019272	86	9.2736185	4.4140049	136	11.6619038	5.1425632
37	6.0827625	3.3322218	87	9.3273791	4.4310476	137	11.7046999	5.1551367
38	6.1644140	3.3619754	88	9.3808315	4.4479602	138	11.7473444	5 1676493
39	6.2449980	3.3912114	89	9.4339811	4.4647451	139	11.7898261	5.1801015
40	6.3254553	3.4199519	90	9.4868330	4.4814047	140	11.8321596	5.1924941
41	6.4031242	3.4482172	91	9.5393920	4.4979414	141	11.8743421	5.2048279
42	6.4807407	3.4760266	92	9.5916630	4.5143574	142	11.9163753	5.2171034
43	6.5574385	3.5033981	93	9.6436508	4.5306549	143	11.9582607	5.2293215
44	6.6332496	3.5303483	94	9.6953597	4.5468359	144	12.0000000	5.2414828
45	6.7082039	3.5568933	95	9.7467943	4.5629026	145	12.0415946	5.2535879
46	6.7823300	3.5830479	96	9.7979590	4.5788570	146	12.0830460	5.2656374
47	6.8556546	3.6088261	97	9.8488578	4.5947009	147	12.1243557	5.2776321
48	6.9282032	3.6342411	98	9.8994949	4.6104363	148	12.1655251	5.2895728
49	7.0000000	3.6593057	99	9.9498744	4.6260650	149	12.2065556	5.3014592
50	7.0710678	3.6840314	100	10.0000000	4.6415888	150	12.2474487	5.3132925

TABLE OF SQUARE ROOTS AND CUBE ROOTS.

Number.	Square Roots.	Cube Roots.	Number.	Square Roots.	Cube Roots.	Number.	Square Roots.	Cube Roots.
151	12.2882057	5.3250740	201	14.1774469	5.8577660	251	15.8429795	6.3079935
152	12.3288280	5.3368033	202	14.2126704	5.8674643	252	15.8745079	6.3163596
153	12.3693169	5.3484812	203	14.2478068	5.8771307	253	15.9059737	6.3247035
154	12.4096736	5.3601084	204	14.2828569	5.8867653	254	15.9373775	6.3330256
155	12.4498996	5.3716854	205	14.3178211	5.8963685	255	15.9687194	6.3413257
156	12.4899960	5.3832126	206	14.3527001	5.9059406	256	16.0000000	6.3496042
157	12.5299641	5.3946907	207	14.3874946	5.9154817	257	16.0312195	6.3578611
158	12.5698051	5.4061202	208	14.4222051	5 9249921	258	16.0623784	6.3660968
159	12.6095202	5.4175015	209	14.4568323	5.9344721	259	16.0934769	6.3743111
160	12.6491106	5.4288352	210	14.4913767	5.9439220	260	16.1245155	6.3825043
161	12.6885775	5.4401218	211	14.5258390	5.9533418	261	16.1554944	6.3906765
162	12.7279221	5.4513618	212	14.5602198	5.9627320	262	16.1864141	6.3988279
163	12.7671453	5.4625556	213	14.5945195	3.9720926	263	16.2172747	6.4069584
164	12 8062485	5.4737087	214	14.6287388	5.9814240	264	16.2480768	6.4150687
165	12.8452326	5.4848066	215	14.6628783	5.9907264	265	16.2788206	6.4231583
166	12.8840987	5.4958647	216	14.6969385	6.0000000	266	16.3095064	6.4312276
167	12.9228480	5.5068784	217	14.7309199	6.0092450	267	16.3401346	6.4392767
168	12.9614814	5.5178484	218	14.7648231	6.0184617	268	16.3707055	6.4473057
169	13.0000000	5.5287748	219	14.7986486	6.0276502	269	16.4012195	6.4553148
170	13.0384048	5.5396583	220	14.8323970	6.0368107	270	16.4316767	6.4633041
171	13.0766968	5.5504991	221	14.8660687	6.0459435	271	16.4620776	6.4712736
172	13.1148770	5.5612978	222	14.8996644	6.0550489	272	16.4924225	6.4792236
173	13.1529464	5.5720546	223	14.9331845	6.0641270	273	16.5227116	6.4871541
174	13.1909060	5.5827702	224	14.9666295	6.0731779	274	16.5529454	6.4950653
175	13.2287566	5.5934447	225	15.0000000	6.0822020	275	16.5831240	6.5029572
176	13.2664992	5.6040787	226	15.0332964	6.0911994	276	16.6132477	6.5108300
177	13.3041347	5.6146724	227	15.0665192	6.1001702	277	16.6433170	6.5186839
178	13.3416641	5.6252263	228	15.0996689	6.1091147	278	16.6733320	6 5265189
179	13.3790882	5.6357408	229	15.1327460	6.1180332	279	16.7032931	6.5343851
180	13.4164079	5.6462162	230	15.1657509	6.1269257	280	16.7332005	6.5421326
181	13.4536240	5.6566528	231	15.1968842	6.1357924	281	16.7630546	6.5499116
182	13.4907376	5.6670511	232	15.2315462	6.1446337	282	16.7928556	6.5576722
183	13.5277493	5.6774114	233	15.2643375	6.1534495	283	16.8226038	6.5654144
184	13.5646600	5.6877340	234	15.2970585	6.1622401	284	16.8522995	6.5731385
185	13 6014705	5.6980192	235	15.3297097	6.1710058	285	16.8819430	6.5808443
186	13.6381817	5.7082675	236	15.3622915	6.1797466	286	16.9115345	6.5885323
187	13.6747943	5.7184791	237	15.3948043	6.1884628	287	16.9410743	6.5962023
188	13.7113092	5.7286543	238	15.4272486	6.1971544	288	16.9705627	6.6038545
189	13.7477271	5.7387936	239	15.4596248	6.2058218	289	17.0000000	6.6114890
190	13.7840488	5.7488971	240	15.4919334	6.2144650	290	17.0293864	6.6191060
191	13.8202750	5.7589652	241	15.5241747	6.2230843	291	17.0587221	6.6267054
192	13.8564065	5.7689982	242	15.5563492	6.2316797	292	17.0880075	6.6342874
193	13.8924440	5.7789966	243	15.5884573	6.2402515	293	17.1172428	6 6418522
194	13.9283883	5.7889604	244	15.6204994	6.2487998	294	17.1464282	6.6493998
195	13.9642400	5.7988900	245	15.6524758	6.2573248	295	17.1755640	6 6569302
196	14.0000000	5.8087857	246	15.6843871	6.2658266	296	17.2046505	6.6644437
197	14.0356688	5.8186479	247	15.7162336	6.2743054	297	17.2336879	6.6719403
198	14.0712473	5.8284767	248	15.7480157	6.2827613	298	17.2626765	6.6794200
199	14.1067360	5.8382725	249	15.7797338	6.2911946	299	17.2916165	6.6868831
200	14.1421356	5.8480355	250	15.8113883	6.2996053	300	17.3205081	6.6943295

Table of Square Roots and Cube Roots.

Number.	Square Roots.	Cube Roots.	Number.	Square Roots.	Cube Roots.	Number.	Square Roots.	Cube Roots.
601	24.5153013	8.4390098	651	25.5147016	8.6668310	701	26.4764046	8.8832661
602	24.5356883	8.4436877	652	25.5342907	8.6712665	702	26.4952826	8.8874882
603	24.5560583	8.4483605	653	25.5538647	8.6756974	703	26.5141472	8.8917063
604	24.5764115	8.4530281	654	25.5734237	8.6801237	704	26.5329983	8.8959204
605	24.5967478	8.4576906	655	25.5929678	8.6845456	705	26.5518361	8.9001304
606	24.6170673	8.4623479	656	25.6124969	8.6889680	706	26.5706605	8.9043366
607	24.6373700	8.4670001	657	25.6320112	8.6933759	707	26.5894716	8.9085387
608	24.6576560	8.4716471	658	25.6515107	8.6977843	708	26.6082694	8.9127369
609	24.6779254	8.4762892	659	25.6709953	8.7021882	709	26.6270539	8.9169311
610	24.6981781	8.4809261	660	25.6904652	8.7065877	710	26.6458252	8.9211214
611	24.7184142	8.4855579	661	25.7099203	8.7109827	711	26.6645833	8.9253078
612	24.7386338	8.4901848	662	25.7293607	8.7153784	712	26.6833281	8.9294902
613	24.7588368	8.4948065	663	25.7487864	8.7197596	713	26.7020598	8.9336687
614	24.7790234	8.4994233	664	25.7681975	8.7241414	714	26.7207784	8.9378433
615	24.7991935	8.5040350	665	25.7875939	8.7285187	715	26.7394839	8.9420140
616	24.8193473	8.5086417	666	25.8069758	8.7328918	716	26.7581763	8.9461809
617	24.8394847	8.5132485	667	25.8263431	8.7372604	717	26.7768557	8.9503438
618	24.8596058	8.5178403	668	25.8456960	8.7416246	718	26.7955220	8.9545029
619	24.8797106	8.5224321	669	25.8650343	8.7459846	719	26.8141754	8.9586581
620	24.8997992	8.5270189	670	25.8843582	8.7503401	720	26.8328157	8.9628095
621	24.9198716	8.5316009	671	25.9036677	8.7546913	721	26.8514432	8.9669570
622	24.9399278	8.3561780	672	25.9229628	8.7590383	722	26.8700577	8.9711007
623	24.9599679	8.5407501	673	25.9422435	8.7633809	723	26.8886593	8.9752406
624	24.9799920	8.5453173	674	25.9615100	8.7677192	724	26.9072481	8.9793766
625	25.0000000	8.5498797	675	25.9807621	8.7720532	725	26.9258240	8.9835089
626	25.0199920	8.5544372	676	26.0000000	8.7763880	726	26.9443872	8.9876373
627	25.0399681	8.5589899	677	26.0192237	8.7807084	727	26.9629375	8.9917620
628	25.0599282	8.5635377	678	26.0384331	8.7850296	728	26.9814751	8.9958829
629	25.0798724	8.5680807	679	26.0576284	8.7893466	729	27.0000000	9.0000000
630	25.0998008	8.5726189	680	26.0768096	8.7936593	730	27.0185122	9.0041134
631	25.1197134	8.5771523	681	26.0959767	8.7979679	731	27.0370117	9.0082229
632	25.1396102	8.5816809	682	26.1151297	8.8022721	732	27.0554985	9.0123288
633	25.1594913	8.5862047	683	26.1342687	8.8065722	733	27.0739727	9.0164309
634	25.1793566	8.5907238	684	26.1533937	8.8108681	734	27.0924344	9.0205293
635	25.1992063	8.5952380	685	26.1725047	8.8151598	735	27.1108884	9.0246239
636	25.2190404	8.5997476	686	26.1916017	8.8194474	736	27.1293199	9.0287149
637	25.2388589	8.6042525	687	26.2106848	8.8237307	737	27.1477439	9.0328021
638	25.2586619	8.6087526	688	26.2297541	8.8280099	738	27.1661554	9.0368857
639	25.2784493	8.6132480	689	26.2488095	8.8322850	739	27.1845544	9.0409655
640	25.2982213	8.6177388	690	26.2678511	8.8365559	740	27.2029410	9.0450419
641	25.3179778	8.6222248	691	26.2868789	8.8408227	741	27.2213152	9.0491142
642	25.3377189	8.6267063	692	26.3058929	8.8450854	742	27.2396769	9.0531831
643	25.3574447	8.6311830	693	26.3248932	8.8493440	743	27.2580263	9.0572482
644	25.3771551	8.6356551	694	26.3438797	8.8535985	744	27.2763634	9.0613098
645	25.3968502	8.6401226	695	26.3628527	8.8578489	745	27.2946881	9.0653677
646	25.4165301	8.6445855	696	26.3818119	8.8620952	746	27.3130006	9.0694220
647	25.4361947	8.6490437	697	26.4007576	8.8663375	747	27.3313007	9.0734726
648	25.4558441	8.6534974	698	26.4196896	8.8705757	748	27.3495887	9.0775197
649	25.4754784	8.6579465	699	26.4386081	8.8748099	749	27.3678644	9.0815631
650	25.4950976	8.6623911	700	26.4575131	8.8790400	750	27.3861279	9.0856030

Table of Square Roots and Cube Roots.

Number.	Square Roots.	Cube Roots.	Number.	Square Roots.	Cube Roots.	Number.	Square Roots.	Cube Roots.
751	27.4043792	9.0896392	801	28.3019434	9.2870440	851	29.1719043	9.4763957
752	27.4226184	9.0936719	802	28.3196045	9.2909072	852	29.1890390	9.4801061
753	27.4408455	9.0977010	803	28.3372546	9.2947671	853	29.2061637	9.4838136
754	27.4590604	9.1017265	804	28.3548938	9.2986239	854	29.2232784	9.4875182
755	27.4772633	9.1057485	805	28.3725219	9.3024775	855	29.2403830	9.4912200
756	27.4954542	9.1097669	806	28.3901391	9.3063278	856	29.2574777	9.4949188
757	27.5136330	9.1137818	807	28.4077454	9.3101750	857	29.2745623	9.4986147
758	27.5317998	9.1177931	808	28.4253408	9.3140190	858	29.2916370	9.5023078
759	27.5499546	9.1218010	809	28.4429253	9.3178599	859	29.3087018	9.5059980
760	27.5680975	9.1258053	810	28.4604989	9.3216975	860	29.3257566	9.5096854
761	27.5862284	9.1298061	811	28.4780617	9.3255320	861	29.3428015	9.5133699
762	27.6043475	9.1338034	812	28.4956137	9.3293634	862	29.3598365	9.5170515
763	27.6224546	9.1377974	813	28.5131549	9.3331916	863	29.3768616	9.5207303
764	27.6405499	9.1417874	814	28.5306852	9.3370167	864	29.3938769	9.5244063
765	27.6586334	9.1457742	815	28.5482048	9.3408386	865	29.4108823	9.5280794
766	27.6767050	9.1497576	816	28.5657137	9.3446575	866	29.4278779	9.5317497
767	27.6947648	9.1537375	817	28.5832119	9.3484731	867	29.4448637	9.5354172
768	27.7128129	9.1577139	818	28.6006993	9.3522857	868	29.4618397	9.5390818
769	27.7308492	9.1616869	819	28.6181760	9.3560952	869	29.4788059	9.5427437
770	27.7488739	9.1656565	820	28.6356421	9.3599016	870	29.4957624	9.5464027
771	27.7668868	9.1696225	821	28.6530976	9.3637049	871	29.5127091	9.5500589
772	27.7848880	9.1735852	822	28.6705424	9.3675051	872	29.5296461	9.5537123
773	27.8028775	9.1775445	823	28.6879766	9.3713022	873	29.5465734	9.5573630
774	27.8208555	9.1815003	824	28.7054002	9.3750963	874	29.5634910	9.5610108
775	27.8388218	9.1854527	825	28.7228132	9.3788873	875	29.5803989	9.5646559
776	27.8567766	9.1894018	826	28.7402157	9.3826752	876	29.5972972	9.5682982
777	27.8747197	9.1933474	827	28.7576077	9.3864600	877	29.6141858	9.5719377
778	27.8926514	9.1972897	828	28.7749891	9.3902419	878	29.6310648	9.5755745
779	27.9105715	9.2012286	829	28.7923601	9.3940206	879	29.6479342	9.5792085
780	27.9284801	9.2051641	830	28.8097206	9.3977964	880	29.6647939	9.5828397
781	27.9463772	9.2090962	831	28.8270706	9.4015691	881	29.6816442	9.5864682
782	27.9642629	9.2130250	832	28.8444102	9.4053387	882	29.6984848	9.5900939
783	27.9821372	9.2169505	833	28.8617394	9.4091054	883	29.7153159	9.5937169
784	28.0000000	9.2208726	834	28.8790582	9.4128690	884	29.7321375	9.5973373
785	28.0178515	9.2247914	835	28.8963666	9.4166297	885	29.7489496	9.6009548
786	28.0356915	9.2287068	836	28.9136646	9.4203873	886	29.7657521	9.6045696
787	28.0535203	9.2326189	837	28.9309523	9.4241420	887	29.7825452	9.6081817
788	28.0713377	9.2365277	838	28.9482297	9.4278936	888	29.7993289	9.6117911
789	28.0891438	9.2404333	839	28.9654967	9.4316423	889	29.8161030	9.6153977
790	28.1069386	9.2443355	840	28.9827535	9.4353880	890	29.8328678	9.6190017
791	28.1247222	9.2482344	841	29.0000000	9.4391307	891	29.8496231	9.6226030
792	28.1424536	9.2521300	842	29.0172363	9.4428704	892	29.8663690	9.6262016
793	28.1602557	9.2560224	843	29.0344623	9.4466072	893	29.8831056	9.6297975
794	28.1780056	9.2599114	844	29.0516781	9.4503410	894	29.8998328	9.6333907
795	28.1957444	9.2637973	845	29.0688837	9.4540719	895	29.9165506	9.6369812
796	28.2134720	9.2676798	846	29.0860791	9.4577999	896	29.9332591	9.6405690
797	28.2311884	9.2715592	847	29.1032644	9.4615249	897	29.9499583	9.6441542
798	28.2488938	9.2754352	848	29.1204396	9.4652470	898	29.9666481	9.6477367
799	28.2665881	9.2793081	849	29.1376046	9.4689661	899	29.9833287	9.6513166
800	28.2842712	9.2831777	850	29.1547595	9.4726824	900	30.0000000	9.6548938

Root.

Table of Square Roots and Cube Roots.

Number.	Square Roots.	Cube Roots.	Number.	Square Roots.	Cube Roots.	Number.	Square Roots.	Cube Roots.
901	30.0166620	9.6584684	951	30.8382879	9.8339238	1001	31.6385840	10.0033322
902	30.0333148	9.6620403	952	30 8544972	9.8373695	1002	31.6543836	10.0066622
903	30 0499584	9.6656096	953	30.8706984	9.8408127	1003	31.6701752	10.0099899
904	30.0675928	9.6691762	954	30.8868904	9.8442536	1004	31.6859590	10.0133155
905	30.0832179	9.6727403	955	30.9030743	9.8476920	1005	31.7017349	10.0166389
906	30 0998339	9.6763017	656	30.9192497	9 8511280	1006	31.7175030	10.0199601
907	30.1164407	9.6798604	957	30.9354166	9.8545617	1007	31.7332633	10.0232791
908	30.1330383	9.6834166	958	30.9515751	9.8579929	1008	31.7490157	10.0265958
909	30.1496269	9.6869701	959	30.9677251	9.8614218	1009	31.7647603	10.0299104
910	30.1662063	9.6905211	960	30.9838668	9.8648483	1010	31.7804972	10.0332228
911	30.1827765	9.6940694	961	31.0000000	9.8682724	1011	31.7962262	10.0365330
912	30.1993377	9.6976151	962	31,0161248	9.8716941	1012	31.8119474	10.0398410
913	30.2158899	9.7011583	963	31.0322413	9.8751135	1013	31.8276609	10.0431469
914	30.2324329	9.7046989	964	31.0483494	9.8785305	1014	31.8433666	10.0464506
915	30.2489669	9.7082369	965	31.0644491	9.8819451	1015	31.8590646	10.0497521
916	30.2654919	9.7117723	966	31,0805405	9.8853574	1016	31,8747549	10.0530514
917	30.2820079	9.7153051	967	31,0966236	9.8887673	1017	31,8904374	10.0563485
918	30.2985148	9.7188354	968	31,1126984	9.8921749	1018	31.9061123	10.0596435
919	30.3150128	9.7223631	969	31.1287648	9.8955801	1019	31,9217794	10.0629364
920	30.3315018	9.7258883	970	31,1448230	9.8989830	1020	31,9374388	10.0662271
921	30.3479818	9.7294109	971	31,1608729	9.9023835	1021	31.9530906	10.0695156
922	30.3644529	9.7329309	972	31.1769145	9.9057817	1022	31.9687347	10.0728020
923	30.3809151	9.7364484	973	31.1929479	9.9091776	1023	31,9843712	10.0760863
924	30.3973683	9.7399634	974	31.2089731	9.9125712	1024	32.0000000	10.0793684
925	30.4138127	9.7434758	975	31.2249900	9.9159624	1025	32,0156212	10.0826484
926	30.4302481	9.7469857	976	31.2409987	9.9193513	1026	32.0312348	10.0859262
927	30.4466747	9.7504930	977	31.2569992	9.9227379	1027	32.0468407	10.0892019
928	30.4630924	9.7539979	978	31.2729915	9.9261222	1028	32.0624391	10.0924755
929	30.4795013	9.7575002	979	31.2889757	9.9295042	1029	32.0780298	10.0957469
930	30.4959014	9.7610001	980	31.3049517	9.9328839	1030	32.0936131	10.0990163
931	30.5122926	9.7644974	981	31.3209195	9.9362613	1031	32.1091887	10.1022835
932	30.5286750	9.7679922	982	31.3368792	9.9396363	1032	32.1247568	10.1055487
933	30.5450187	9.7714845	983	31.3528308	9.9430092	1033	32.1403173	10.1088117
934	30.5614136	9.7749743	984	31.3687743	9.9463797	1034	32.1558704	10.1120726
935	30.5777697	9.7784616	985	31.3847097	9.9497479	1035	32.1714159	10.1153314
936	30.5941171	9.7829466	986	31.4006369	9.9531138	1036	32.1869539	10.1185882
937	30.6104557	9.7854288	987	31.4165561	9.9564775	1037	32,2024844	10.1218428
938	30.6267857	9.7889087	988	31.4324673	9.9598389	1038	32.2180074	10.1250953
939	30.6431069	9.7923861	989	31.4483704	9.9631981	1039	32.2335229	10.1283457
940	30.6594194	9.7958611	990	31.4642654	9.9665549	1040	32,2490310	10.1315941
941	30 6757233	9.7993336	991	31.4801525	9.9699095	1041	32.2645316	10.1348403
942	30.6920185	9.8028036	992	31.4960315	9.9732619	1042	32.2800248	10.1380845
943	30.7083051	9.8062711	993	31.5119025	9 9766120	1043	32.2955105	10.1413266
944	30.7245830	9.8097362	994	31.5277655	9.9799599	1044	32.3109888	10.1445667
945	30.7408523	9.8131989	995	31.5436206	9.9833055	1045	32.3264598	10.1478047
946	30.7571130	9.8166591	996	31.5594677	9.9866488	1046	32.3419233	10.1510406
947	30.7733651	9,8201169	997	31.5753068	9.9899900	1047	32.3573794	10.1542744
948	30.7896086	9.8235723	998	31.5911380	9.9933289	1048	32.3728281	10.1575062
949	30.8058436	9.8270252	999	31.6069613	9 9996656	1049	32.3882695	10.1607359
950	30.8220700	9.8304757	1000	31.6227766	10.0000000	1050	32.4037035	10.1639636

TABLE OF SQUARE ROOTS AND CUBE ROOTS.

Number.	Square Roots.	Cube Roots.	Number.	Square Roots.	Cube Roots.	Number.	Square Roots.	Cube Roots.
1051	32.4191301	10.1671893	1101	33.1813200	10.3259284	1151	33.9263909	10.4799314
1052	32.4345495	10.1704129	1102	33.1963853	10.3290537	1152	33.9411255	10.4829656
1053	32.4499615	10.1736344	1103	33.2114488	10.3321770	1153	33.9558537	10.4859980
1054	32.4653662	10.1768539	1104	33.2264955	10.3352985	1154	33.9705755	10.4890286
1055	32.4807635	10.1800714	1105	33.2415403	10.3384181	1155	33.9852910	10.4920575
1056	32.4961536	10.1832868	1106	33.2565783	10.3415358	1156	34.0000000	10.4950847
1057	32.5115364	10.1865002	1107	33.2716095	10.3446517	1157	34.0147027	10.4981101
1058	32.5269119	10.1897116	1108	33.2866339	10.3477657	1158	34.0293990	10.5011337
1059	32.5422802	10.1929209	1109	33.3016516	10.3508778	1159	34.0440890	10.5041556
1060	32.5576412	10.1961283	1110	33.3166625	10.3539880	1160	34.0587727	10.5071757
1061	32.5729949	10.1993336	1111	33.3316666	10.3570964	1161	34.0734501	10.5101942
1062	32.5883415	10.2025369	1112	33.3466640	10.3602029	1162	34.0881211	10.5132109
1063	32.6036807	10.2057382	1113	33.3616546	10.3633076	1163	34.1027858	10.5162259
1064	32.6190129	10.2089375	1114	33.3766385	10.3664103	1164	34.1174442	10.5192391
1065	32.6343377	10.2121347	1115	33.3916157	10.3695113	1165	34.1320963	10.5222506
1066	32.6496554	10.2153300	1116	33.4065862	10.3726103	1166	34.1467422	10.5252604
1067	32.6649659	10.2185233	1117	33.4215499	10.3757076	1167	34.1613817	10.5282685
1068	32.6802693	10.2217146	1118	33.4365070	10.3788030	1168	34.1760150	10.5312749
1069	32.6955654	10.2249039	1119	33 4514573	10.3818965	1169	34.1906420	10.5342795
1070	32.7108544	10.2280912	1120	33.4664011	10.3849882	1170	34.2052627	10.5372825
1071	32.7261363	10.2312766	1121	33.4813381	10.3880781	1171	34.2198873	10.5402837
1072	32.7414111	10.2344599	1122	33.4962684	10.3911661	1172	34.2344855	10.5432832
1073	32.7566787	10.2376413	1123	33 5111921	10.3942523	1173	34.2490875	10.5462810
1074	32.7719392	10.2408207	1124	33.5261092	10.3973366	1174	34 2636834	10.5492771
1075	32.7871926	10.2439981	1125	33.5410196	10.4004192	1175	34.2782730	10.5522715
1076	32.8024389	10.2471735	1126	33.5559234	10.4934999	1176	34.2928564	10.5552642
1077	32.8176782	10.2503470	1127	33.5708206	10.4065787	1177	34.3074336	10.5582552
1078	32.8329103	10.2535186	1128	33.5857112	10.4096557	1178	34.3220046	10.5612445
1079	32 8481354	10.2566881	1129	33.6005952	10.4127310	1179	34.3365694	10.5642322
1080	32.8633535	10.2598557	1130	33.6154726	10.4158044	1180	34 3511281	10.5672181
1081	32.8785644	10.2630213	1131	33.6303434	10.4188769	1181	34.3656805	10.5702024
1082	32.8937684	10.2661850	1132	33.6452077	10.4219457	1182	34.3802268	10.5731849
1083	32.9089653	10.2693467	1133	33 6600653	10.4250138	1183	34.3947670	10.5761658
1084	32.9241553	10.2725065	1134	33.6749165	10.4280800	1184	34.4093011	10.5791449
1085	32.9393382	10.2756644	1135	33.6897610	10.4311443	1185	34.4238289	10.5821225
1086	32.9545141	10.2788203	1136	33.7045991	10.4342067	1186	34.4383507	10.5850983
1087	32.9696830	10.2819743	1137	33.7194306	10.4372676	1187	34.4528663	10.5880725
1088	32 9848450	10.2851264	1138	33.7342556	10.4403267	1188	34.4673759	10.5910450
1089	33.0000000	10.2882765	1139	33.7490741	10.4433839	1189	34.4818793	10.5940158
1090	33.0151480	10.2914247	1140	33.7638860	10.4464393	1190	34.4963766	10.5969850
1091	33.0302891	10.2945709	1141	33.7786915	10.4494929	1191	34.5108678	10.5999525
1092	33.0454233	10.2977153	1142	33.7934905	10.4525448	1192	34.5253530	10.6029184
1093	33.0605505	10.3008577	1143	33.8082830	10.4555948	1193	34.5398321	10.6058826
1094	33.0756708	10.3039982	1144	33.8230691	10.4586431	1194	34.5543051	10.6088451
1095	33.0907842	10.3071368	1145	33.8378486	10.4616896	1195	34.5687720	10.6118060
1096	33.1058907	10.3102735	1146	33.8526218	10.4647343	1196	34.5832329	10.6147652
1097	33.1209903	10.3134083	1147	33.8673884	10.4677778	1197	34.5976879	10.6177228
1098	33.1360830	10.3165411	1148	33.8821487	10.4708185	1198	34.6121366	10.6206788
1099	33.1511689	10.3196721	1149	33.8969025	10.4738579	1199	34.6265794	10.6236331
1100	33.1662479	10.3228012	1150	33.9116499	10.4768955	1200	34.6410162	10.6265857

ROPEMAKING.

Rope-making.

ROPEMAKING is a highly important and useful art, by which a great number of delicate fibres are combined together.

The fibres most commonly used in the manufacture of ropes, are those of hemp, the best kinds of which come from the south of Russia, and are imported into England from Riga and St. Petersburgh.

Fibres of hemp.

The fibres of hemp which compose a rope, seldom exceed in length three feet and a half at an average. They must therefore be twined together so as to unite them into one, and this union is effected by the mutual compression of the two fibres. If this compression is too great, the strength of the fibres at the part where they join will be diminished, so that it becomes a matter of great consequence to give them only that degree of twist which is essential to their union.

Spinning the yarn.

The first part of the process of ropemaking, is that of spinning the yarns or threads, which is done in a manner analogous to that of ordinary spinning. The spinner carries a bundle of dressed hemp round his waist. The two ends of the bundle unite in front. Having drawn out a proper number of fibres with his hand, he twists them with his fingers, and fixing this twisted part to the hook of a whirl, which is driven by a wheel put in motion by an assistant, he walks backward down the ropewalk, the twisted part always drawing out of the bundle round his waist more fibres as in the common spinning wheel. The spinner takes care that these fibres are properly supplied, and that they always enter the twisted part with their ends, and never by their middle. As soon as he has reached the end of the walk, another spinner takes the yarn off the whirl, and gives it to another person to put upon a reel, while he himself attaches his own hemp to the whirl hook, and proceeds down the walk. When the person at the reel begins to turn, the first spinner who has completed his yarn holds it firmly at the end, and advances slowly up the walk while the reel is turning, keeping it equally tight all the way, till he reaches the reel, where he waits till the second spinner takes his yarn off the whirl hook, and joins it to the end of that of the first spinner, in order that it may follow it on the reel.

Size of rope yarns.

The common size of rope yarns is from one-twelfth of an inch in diameter, to a little more than one-ninth of an inch, about 160 fathoms of them weighing from two and a half to four pounds, as in the following table, the first column showing the sizes of the yarns.

Sizes.	lbs.	oz.	drs.	Sizes.	lbs.	oz.	drs.
16	4	0	0	21	3	0	4
17	3	12	4	22	2	14	7
18	3	8	14	23	2	12	8
19	3	5	14	24	2	10	10
20	3	3	3	25	2	8	15

Warping the yarns.

The next part of the process is that of *warping the yarns*, or stretching them all to one given length, previous to their being tarred, which is about two hundred fathoms in full length rope grounds, and also in putting a slight turn or twist into them.

Tarring the yarn.

The third process in ropemaking is the tarring of the yarn. Sometimes the yarns are made to wind off one reel, and having passed through a vessel of hot tar, are wound up on another, the superfluous tar being removed by causing the yarn to pass through a hole surrounded with spongy oakum; but the general method is to tar it in skains or hanks, which are drawn by a capstan with a uniform motion through the tar kettle. In this process great care must be taken that the tar is boiling neither too fast nor too slow. Yarn for cables requires more tar than for hawser laid ropes, and for standing and running rigging it requires only to be well covered. Tarred cordage has been found to be weaker than what is untarred when it is new, but the tarred rope acquires strength by keeping.

The last part of the process of ropemaking is to lay the cordage. For this purpose two or more yarns are attached at one end to a hook. The hook is then turned the contrary way from the twist of the individual yarn, and thus forms what is called a *strand*. Three strands, sometimes four, besides a central one, are then stretched at length, and attached at one end to three contiguous but separate hooks, and at the other end to a single hook, and the process of combining them together, which is effected by turning the single hook in a direction contrary to that of the other three, consists in so regulating the progress of the twists of the strands round their common axis, that the three strands receive separately at their opposite ends just as much twist as is taken out of them by their twisting the contrary way in the process of combination. In this way is formed what is technically called a *shroud laid rope*.

Such was probably the whole process of ropemaking for many ages, till the progress of the maritime art required the use of ropes of a much larger size; for this could not be advantageously effected by increasing the number of yarns in a strand. Were we to attempt to compose a strand of a great number of yarns, the plan would not have a sufficient number of turns round their common axis to prevent them from slipping when the yarn is stretched; many of the fibres would be broken on being twisted together into one spiral, "because," as Mr. Chapman remarks, "the outward coat of threads or yarns is exposed to more stress than the internal ones, as will be very evident when it is considered that when two or three hundred yarns are all stretched at length to form one cylindric mass, they will lie at different distances from the centre of the cylinder, and that, when twisted together, the outside yarns form a spiral of some given number of turns round the mass of the included yarns, forming a considerable diameter, and are therefore much shortened; whilst the inner yarns take only the same number of turns round a reduced axis, and from that cause should be less shortened. Therefore it follows, that the outside yarns only can be in full tension, whilst those within must be more or less puckered up, according to their proximity to the centre."

From these causes, cables, or large ropes which are said to be *cable laid*, are formed by the combination of lesser ropes twisted around their common axis, in the same manner as a shroud laid rope is formed by the combination of strands twisted round their common axis. Cables of water ropes are formed on this principle, even when their size is not very great, as they are thus made more hard and compact, which makes them resist the easy admission of water.

Such is a brief and general account of the state of the rope manufacture till the end of the last century, when various successful attempts were made not only to improve the quality of ropes, but to facilitate the process of making them.

We shall now endeavour to give an account of these important improvements, taking for our guide Mr. Chapman's *Treatise on the Progressive endeavours to improve the Manufacture and Duration of Cordage.*

So early as 1783, Mr. Sylvester proposed to supersede the necessity of a rope ground, by employing a machine, of which he deposited a model with the Society of Arts, which we have had occasion to examine. In order that the manufacture might be carried on in a house, he spun the thread on a bobbin and spindle, and the yarns which composed the strands were wound on three separate reels fixed on frames, which turned individually round their axis, and also round a common centre, in consequence of which motions they were twisted into a rope, which was to be wound up as it was made. Mr. Chapman mentions, that the defect of the machine was, that the process of making the strands, and twisting them into a rope, was performed by two successive operations as in a rope ground, portions of the threads being first made, and these portions afterwards combined into a rope. Our recollection of the machine, however, is, that both operations were performed at the same time.

Be this as it may, however, the invention was given gratuitously to the public, and as the inventor took out no patent, it was never carried into effect,—the general result of most inventions, where no inducement is held out to bring them into actual practice.

In 1784, Mr. Benjamin Seymour took out a patent for a new method of making ropes; but this seems to have been nothing more than the substitution of horses in place of men, for driving the machinery then in use.

The Rev. E. Cartwright took a patent in 1792, for his *Cordelier*, a machine for making ropes. This invention appears to have been the same as Mr. Sylvester's; but differed from it, according to Mr. Chapman, in the circumstance of the motions for twisting the strands, and making the rope, going on at the same time.

The advantages of making ropes by machinery seems to have been considered so great, that the attention of many ingenious individuals was about this time directed to the subject.

In the year 1793, no fewer than three patents were taken out for improved methods of making ropes. Mr. R. Fothergill, of Sunderland, secured by patent, in 1793, his invention of a method of heckling and preparing the hemp, and of spinning it into rope yarn, and of a machine for making the rope. This machine, which we have represented in Plate CCCCLXXXII. Fig. 1. is on the same principle as Mr. Cartwright's. The object of it was, to make ropes without the necessity of a rope ground, and to diminish the labour of the manufacturer. In the perspective view of this machine given in the figure, A represents the platform, by the revolutions of which the three strands are twisted into a rope at their place of junction B, from which it is drawn forward at C as it is made by the revolution of the wheel D. The three separate reels that contain the strands are shown at E, E, E, and contain the proper number and length of yarns necessary for a strand. These reels revolve round their individual axes, at the same time that they are all carried round by the frame A, which supports them. For a drawing of Mr. Fothergill's machinery for slivering and drawing out the hemp, and of his yarn spindle and bobbin, we must refer the reader to Mr. Chapman's work, already quoted. This machinery was erected on a very large scale at Southwick, on the river Wear.

Mr. Balfour's patent, 1793.

In the same year, Mr. J. D. Balfour, of Elsineur, took out a patent for "a new invented machine for manufacturing ropes and cordage." The principal object of Mr. Balfour's invention was, to remedy the defect in the usual method of making the strand; in consequence of which, a given number of spirals round a large cylinder, must require a greater length of yarn than the same number of spirals formed round a small cylinder, having its axis of the same length as the large one.

In order to avoid this evil, Mr. Balfour stretched out at length upon a rope ground all the yarns which were to compose the strand, to the same length as the proposed strand. The remaining length of the yarns, or the excess of the length of the yarns above the required length of the strand, was to be wound up on as many bobbins as there were yarns placed upon a large frame. The yarns were separated at intervals throughout their whole length from the frame to the commencement, where they all united either through holes arranged in concentric circles, or round the notches of an apparatus, which he called a top minor. The whole of the yarns were then twisted at that end, the top minor retiring as the twist advanced. As the yarns at the opposite end would remove from the bobbins no more than was necessary from their position in the internal or external part of the spiral, they would of course be of different lengths. "This plan," says Mr. Chapman, "was very ingenious, and had much merit in its principle, although defective in stopping short of what would effect the ultimate purpose of causing all the yarns to bear alike on breaking the rope. Before a rope is brought to its breaking stress, both it and the strands composing it are much elongated, and their diameters greatly reduced. Now, under any reduction of diameter of strand, it is apparent that the outside coat of yarns must slacken considerably, and give no support to the internal yarns, which, from the smallness of the spiral, could elongate but little, and must of course break in succession from the centre outwards. In addition to this defective circumstance, the mode of operation was so complex and laborious, as to prevent its adoption. This invention of Mr. Balfour's, though defective and nugatory, has nevertheless been the basis of all future improvements."

Mr. Huddart's first patent, 1793.

The defect in Mr. Balfour's method was very ingeniously supplied by Mr. Joseph Huddart of Islington's "new mode of making great cables, and other cordage, so as to obtain a greater degree of strength therein, by a more equal distribution of strain upon the yarns." This method was secured by patent, in 1793, and was suggested by a practice which Mr. Huddart had seen among the negroes in the West Indies, in making lines of a certain description. Behind the top minor of Mr. Balfour, Mr. Huddart places a tube, consisting of two parts, divided longitudinally, and overlapping each other. These tubes, made of thin steel, and brought to a spring temper, may be more or less compressed. Mr. Huddart's top minor consists of a plate, perforated with a proper number of holes for the yarns, arranged in concentric circles; and at a distance from the plate, sufficient to allow the yarns to be easily concentrated, is placed the above-mentioned tube, which is connected with a register, which indicates the proper angle of twist during that process, and regulates the increased angle of the next process. The reels which held the yarns, were placed at the head of the rope ground in a stationary frame, and as the strand was twisted by the hook of a sledge, the register advanced towards the stationary frame. To the mass of yarn thus formed into a strand, Mr. Huddart gave an additional twist, by which the strand was shortened, and a compensation made for the effects of a reduction of its diameter by stretching. Mr. Huddart likewise proposed a method of twisting the yarns while they were forming into a strand, in order to counteract the diminution of strength which would have arisen from the untwisting produced by the countertwist of the strand.

Mr. Chapman's first patent, 1797.

Such was the state of the rope manufacture, when Mr. Chapman of Newcastle took out his first patent for the improvement of cordage, and which was followed by a series of other patents, which appear to have contributed greatly to the present improved state of the rope manufacture. His first patent, dated in 1797, had for its object to dispense with rope grounds, and to reduce the expence of the manufacture. The strands revolved round their own axis only, and the rope was formed by the revolution of a separate axis on which it was wound.

Mr. Chapman's second patent, 1798.

Mr. Chapman's second patent, dated 1798, consisted in tarring the yarns so as to cause them all to wind up singly as they came from the tar kettle; and in making the strand separately by house machinery, and in two distinct methods. The first of these methods consisted in having the yarns on separate reels fixed on a platform, supported by the revolving shaft or frame, by which, when the yarns were brought to a focus, the strand was to be twisted, and thence drawn forward and coiled up by *machinery in a stationary position*. The second method consisted in having the reels in a stationary frame, and conducting the yarns separately into one focus over to a revolving shaft or frame, in which the strand has *to be wound up as made*, and which *contained the machinery for hauling forward* the yarns which composed the strand. The hauling-forward machinery consisted of two rollers on a stationary and separate frame, close to the opening in the top of the revolving shaft, which twisted the yarn prepared for a strand, and contained the reel on which it was wound up. The two rollers by which the yarns were compressed and brought forward, drew them out to the same length, and prevented the yarn from being twisted into a mass. The strands thus made, were proved by public experiments to be greatly superior to those made by the old methods.

Mr. Balfour's second patent, 1798.

In the same year, viz. 1798, Mr. Balfour took out a second patent for improvements on his former method of manufacturing ropes, which was successfully tried in the king's yards, and for which he received a premium of some thousand pounds from the navy board.

Mr. Chapman's third patent, 1798.

The backward motion of the sledge which was introduced by Mr. Balfour, and which affords the most simple and perfect method of forming strands, led Mr. Chapman to the idea of regulating the motion of the sledge; so that for every revolution of the strand the sledge should move backwards through the exact length of axis assigned to it, and thus render the twist uniform. He therefore took out a patent in 1798, for his method of effecting this, which he thus describes: This object he attained, "by stretching a rope, which he called a ground rope, the whole length of the ropery, and upon the floor of it. This rope was passed, in the form of an S, partially round two or more grooved wheels with horizontal axes, fixed with other apparatus on the common machine for making ropes, technically called a sledge, but which for that purpose is fitted with wheels to travel on a railroad. The grooved wheels press against each other to bind the rope, and have upon their axes toothed wheels, connecting them with each other; and finally with the hooks for turning the strands, which, in this instance, are all turned by one great crank, intervening between the hooks and the wheels appropriated to the backward motion, and connected with the ground rope. Thus when the hooks were turned by the crank, the sledge was also drawn backwards, by the turning of the grooved wheels which received any determinate motion to that of the strand hooks, by means of changeable wheels easily taken off and on. In the preceding instance, the labour of the men is relieved by a rope leading from the sledge to a horse capstan, at the foot of the ropery. In consequence of the ground rope, (which is capable either of drawing the sledge forward, or retarding its motion,) the horse cannot draw the sledge faster than it ought to move; but his spare power is given in aid of twisting the strands through the intervention of the wheels, which connect that operation with the backward motion."

Several ropeworks were erected under this patent on the river Tyne, Mr. Chapman having fitted up each ropery with all the apparatus for £560; and the ropes which were made were greatly superior to others. The *strands* made on the improved principle, were as strong as common made ropes, when the girt of the former was to that of the latter as 71 to 94 upon an average of 14 ropes, from 3 to 10 inches in girt; and the *cables* were as strong as common made ones, when the girt of the former was to that of the latter as 143 to 189 upon an average of 14 cables, from 5½ to 20 inches in girt.

In the year 1798, a new kind of rope was introduced by Mr. John Curr of Sheffield, who took up a patent for "a method of forming and making a *flat rope* intended to be used in drawing coals and other minerals and waters out of mines of any kind." These ropes are formed by connecting two or more small ropes sidewise together by sewing or stitching, lapping or interlacing with thread or small ropes. Mr. Curr found it necessary to make the component ropes alternately of a right and left hand twist to keep the flat rope in a quiescent state. In the tenth volume of the Repertory of Arts, first series, will be found a description of the machine for stitching the ropes together.

Mr. Balfour, whose exertions in improving the manufacture of cordage were indefatigable, took out a third patent in 1799, for an improvement on his former methods of making ropes. This patent contains three important improvements:

1. He proposes that any number of yarns not above four, shall be wound on each reel, and he has given a method of winding them so as to cause them to unwind equally. This original idea afterwards led to a still greater improvement.

2. He proposes to spin the hemp when tarred.

3. In order to prevent loss of time when the spinners are returning, he proposes to have a wheel at both ends of the rope ground, so that in place of returning when they have reached the end of the rope ground, the spinners spin back again. In this case boys take the threads off the hooks and lay them at their length on one side.

In July 1799, Messrs. W. and E. W. Chapman took out another patent for a method of applying a steam engine to the locomotive machinery in rope grounds, and for other inventions. The first object of these inventions was to improve the method of spinning the yarn by having the fibres of the hemp laid in the yarn in the same manner as the yarns themselves are laid in the strand. The machinery for this purpose consists only of a spindle divided into two parts, the upper containing apparatus to draw forward the hemp from the spinner with twist sufficient to combine the fibres, which enabled them to employ women, children, and invalids, and to appropriate the rope ground for the purpose of laying ropes. Another object of the patentee was to give to the yarns in the act of their being spun, that counter-twist to that of the strand, which Mr. Huddart in his patent of 1799, had given them during the operation of making the strand. Mr. Chapman produced this effect either by dividing the spindle, and giving it two separate motions, or by two separate operations, the last of which methods was preferred.

Mr. James Mitchel of Poplar took out a patent in 1799, for "a method of manufacturing cables, hawsers, or strand laid ropes, &c. on a scientific principle." This principle consists in slightly twisting a small number of yarns together previously to the formation of the strand, and these slightly twisted sets of yarns were united in the strand as so many single yarns. This was a happy improvement on the idea of Mr. Balfour, who overlooked the propriety of giving the yarns upon his reels a slight twist.

In the same year, Mr. J. Grimshaw took out a patent which embraced four objects. 1. That of splitting the hemp previous to spinning. 2. That of winding up the yarns. 3. That of preparing the yarns for tarring, and 4, That of laying the ropes and the strands. To accomplish the first of these objects, he makes the heads of hemp, when spread out, pass through conical fluted rollers of the form of truncated cones, before they come to the rotative heckles, so that by this means the hemp is very equally mixed. In winding up the yarns and preparing them for tarring, he uses a long cylindrical barrel which contains the whole length to be tarred at once. Before the tarring takes place the yarns are drawn from the cylinder, and coiled away in a revolving tub, so that the mass of yarns are twisted together and prepared to go through the tar kettle, from which they are again coiled away in a tub in a similar manner before they are separated. In forming the strands or ropes, Mr. Grimshaw uses a *top* or conical block of wood, along the grooves of which the strands converge into a point, where they are combined into a rope. This top follows the central motion of the rope machine, and the rope, when formed, is coiled upon a stationary barrel of such a size as will hold the whole rope without any double coils. The same plan is used by Mr. Grimshaw in forming the strands from the yarns. Mr. Grimshaw erected the rope works of Southwick and succeeded Mr. Fothergill, whose patent we have already noticed.

In August 1799, Mr. Huddart took a second patent, intitled for an "improved method of registering or forming the strands in the machinery for manufacturing cordage." The machinery described in the patent was erected at Mr. Huddart's ropework at Limehouse. A cable of twenty inches girth made by it was subjected to experiment and found far superior to the cordage made in the usual way. A steam-engine was employed by Mr. Huddart in the formation of the shroud strand.

In 1800, Mr. Huddart secured in a third patent his right to "certain improvements in tarring and manufacturing cordage." These improvements seem to have been very important. The new method of tarring, &c. here described, consists in registering the strands of ropes during the operation of tarring, which is done in the following manner: The kettle is covered so as to retain the evaporated matter, which thickens the tar if it is allowed to escape, and consequently makes the yarn too pitchy. The heat of the tar is regulated by a thermometer.* The ropes made by this process are said to be particularly compact and firm.

Mr. Hoard's patent, 1801.

In 1801, Mr. Hoard took a patent for "a portable machine for manufacturing ropes and cordage of any length in a short space, particularly adapted for shipping." This portable machine consists of separate reels, one containing the full length and number of yarns necessary for making a strand. From this reel the yarns are drawn out to the distance at which the two reels can be placed, and are then attached to the other reel which is empty, one of the reels being moveable on a sledge. The strand between the reels is then twisted, until the reels have advanced towards each other through the usual space, viz. *one-fifth*. The portion of the strand thus twisted and formed, is wound up on the second reel, and then so much more of the yarns uncoiled from the first reel as will bring the reels to the greatest distance. The rope is made on two reels from the three strands, just as the strand was made from the yarns, with this difference only that a top is used to regulate the twist of the rope.

Mr. A. Thompson's patent, 1801.

In 1801, Mr. A. Thompson took out a patent for "improved machinery for spinning rope yarns, and sail cloth yarns, and for laying and making ropes and cordage." The following is the account given of this patent by Mr. Chapman: "Preparatory to spinning, he draws out the hemp into a long sliver by different sets of chain heckles, moving with progressively greater speed; and in the end the sliver is spun by a spindle with its plyer and bobbin into a thread. The threads remain wound up on their bobbins until wanted to be made into a rope, tarred or untarred. The bobbins are then, according to the number of yarns wanted on a strand, placed so as to form two circles of the same diameter round an open cylinder, consisting of three hoops or rings, distant from each other the length of a bobbin, and placed near to one end of a long horizontal axis; and, if the rope be to be tarred the yarns are led through a ring of a few inches diameter, near that end of the described open cylinder which has the spare length of axis projecting from it. The yarns are then diverged in different degrees so as to form, when passed longitudinally through an open cylindric frame of several feet in length, so many different concentric circles round the axis mentioned, as there are different shells (or concentric coats) of yarns in the strand; and from the further extremity of this last mentioned cylindric frame, the yarns are concentred to one focus at the extremity of the axis, which is there concave, and has an opening through which the yarns pass to the machine which is to twist them into a strand, and draw them forward to be coiled up within itself. At the focal point described, there are nippers to express the tar from the yarns, which is put into them in the following manner, viz: the last mentioned open cylinder between the ring from which the yarns enter to it, and the perforation of the axis where they concentre and quit it, lies over a tar kettle and has a portion of its lower half immersed in the tar just so far as to imbue either the whole or any portion of the yarns with tar as may be deemed expedient. This cylinder must of course turn round with such convenient degree of speed as not to let the yarns be drawn off the cylinder before it comes in their rotation to pass through the tar. When the full length of strand is made, the twist of which is principally given by the revolution of the frame, in which it is progressively wound up during the process of making, the yarns are cut off; and three of these strands, from so many stationary strand frames (each of which has performed the operation last described, revolving only round its own separate axis) are concentred together, and pass through the axis of one end of a rotatory frame, which twists them into a rope and coils it up progressively as made, upon a barrel within the frame."

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* Mr. Huddart does not mention the proper heat. In the common practice it is between 212° and 250° of Fahrenheit.

Mr. W. Chapman's patent for preserving cordage, 1802.

In the year 1802, Mr. W. Chapman took out a patent "for the application of certain substances either separate or combined as a preservative for cordage."

As it had been proved by Duhamel and others, whose experiments we have detailed at the end of this article, that cordage was injured by the operation of tarring, it became a matter of great consequence to ascertain the cause of this, and to obtain the advantages acknowledged on all hands to belong to tarring, without the evils which accompanied it.

As tar was known to be soluble in water, attempts had been made to defend cordage from the water by oils and fatty bodies, which do not mix with it; but the application of these unguents was found to interfere with the twisting of the fibres. Tanning has also been used, but though it is found useful in the net manufacture, it is not employed in cordage.

Mr. Chapman, to whom the rope manufacture owes so much, directed his attention to the subject, and seems to have obtained very important results. He had found that rope yarn is considerably weakened by passing through the tar kettle; that tarred cordage loses its strength progressively in cold climates, and so rapidly in hot climates that it is scarcely fit for use in three years.

Mr. Chapman, therefore, set himself to discover a preserving substance with the following properties:

1. That it should not be soluble in water.
2. That it should not become rigid by length of time, as the rope which imbibed it would be weakened by sudden bendings.
3. That it should be free of any acid or essential oil capable of being disengaged by heat, for these ingredients occasion the dry rot in cordage.

Mr. Chapman found that tar could be rendered fit, by the following process, for becoming a preservative of cordage:

1. By boiling it in water, which will extract from it its superabundant acid, and its mucilage, which contains a disengaged acid.
2. By repeating and combining these processes till the tar has become more pitchy, by having thrown off a larger portion of its essential oil, and by restoring the plasticity which it has thus lost by the addition of suet, tallow, animal oils, or expressed oils that may have the same effect.

Mr. William Allen's report on the effects of common tar on cordage.

The following report drawn up by our celebrated countryman Mr. William Allen, on the advantages of using Mr. W. Chapman's preparations of tar in cordage, is too valuable a document to be omitted here.

"Common tar, unprepared, contains a quantity of vegetable acid; and, apprehending that this acid might injure the texture of cordage, the following experiment was made:—A piece of twine, which, by previous trial, was found capable of supporting 61 lbs. without breaking, was immersed in vegetable acid, and after 46 hours it was so much injured that it broke with a weight of less than 16 lbs. A piece of the same twine was immersed for 46 hours in the essential oil, which came over in distillation from the jar; and, although it had suffered no diminution of strength at the termination of its immersion, yet after being exposed three days to the air, it was only capable of bearing 31 pounds.

The Stockholm tar used in these experiments was found to contain about seven per cent. of vegetable mucilage, capable of being converted into acid in a hot climate, when the cordage is immersed in water; the tar also contained as much real acid as there is in an *equal measure of common vinegar;* but by repeatedly boiling the tar in water, according to the method prescribed, it is freed from its acid and mucilage, and may be employed in the manufacture of cordage with great advantage, in the place of common tar. Also, if the prepared tar be boiled down so much further as to deprive it of that portion of its essential oil which it is found necessary to retain to prevent tarred cordage being too rigid, and the place of the essential oil be supplied with a due portion of fixed or expressed oil, it is probable that those injuries will be done away, which arise from the action of essential oil on the fibres of the hemp, and from the rigidity of cordage experienced in vessels returning to cold from hot climates where the essential oil is considerably thrown off."

In 1802 the additional expence of using purified tar amounted to about one pound sterling per ton, and the experiments made on ropes tarred by this new method, will be found at the end of this article. A vessel was fitted out by Mr. Renwick of Newcastle, having the cordage partly tarred in the common way, and partly with purified tar, but she was unfortunately lost on her first voyage.

In 1802 another patent was taken out by Messrs James Mitchell, Sen. and Junior, for an improved method of manufacturing cables, hawsers, and other cordage. We have already seen that, in his patent of 1799, Mr. Mitchell gave a slight twist to a small number of yarns, which were combined into the strand as if they were as many single yarns. The twist which he gave to these sets or parcels of yarn was only such as to shorten them between *three* and *five* fathoms in every *two hundred* fathoms. The object of the present patent is to facilitate the progress of combining these parcels of yarn. After placing the sledge at a proper distance from the head of the ropery, they attach as many parcels of yarns as are wanted to as many hooks on the tackle-board at the head of the ropery, and run them down over the stake heads in parallel lines. This is accomplished by what is called a *bedder*, which admits and compresses each division separately, and retires towards the sledge, the parcels of yarn receiving their twist from the hooks on the tackle-board. The strand is then made from those twisted parcels of yarn in the ordinary way. After giving an account of other analogous processes, the patentee states, that the parcels of yarn may be twisted "without rotation on the axes, by the simple process of thorough putting the parts or subdivisions when coiled above the boards," and drawing them on through the proper distances, after they had been passed through holes in the tackle-board.

Mr. Huddart took out in 1805 a fourth patent for a system of machinery, which, "though not new when taken separately, tends to lay cables in a manner that is to all essential and substantial purposes new." This machine is composed of three strand frames, which revolve round a common axis. Fixed to that axis, and revolving with it, is a top, along whose grooves the strands pass to their point of union, where they are formed into a rope, which is drawn away, when made, by grooved wheels. This machine seems to combine some of the parts of Cartwright's Cordelier, and of Fothergill and Grimshaw's Machines.

In 1806 Mr. Curr of Sheffield secured, by a patent, "a method of spinning hemp for making ropes or cordage." In order to regulate the number of twists in the yarn to the distance moved through by the spinner, he connects a barrel with the spinning wheel, and therefore with the whirls which twist the yarn. The speed and motion of the spinner (with whom the rest keep pace) is regulated by means of the rope attached to his body unwinding itself from the barrel above-mentioned. The great object of Mr. Curr's method is to produce an equal elongation of the yarns when the twist is taken out of them by the opposite twist of the strand.

This patent was immediately followed by another by the same patentee, "for a method of laying or twisting the yarns, by which they have a better and more equal bearing than they have in the common way." In the specification of this patent, Mr. Curr describes a method of regulating the motion of the top, and also of giving a regular motion to a perforated implement, which is a substitute for Mr. Balfour's top minor.

In the year 1806 Mr. R. Walker took out a patent for an "improved method of making ropes of every dimension by not only making all the yarns bear equally in the strand, and laying the strands uniformly in the rope, but also by making the rope or cordage from the yarns in the same operation." In this machine the rope is twisted by the same frame which twists the strands; and the principal difference between this and several other patent machines is, that Mr. Walker has each yarn wound on its own bobbin, and arranged in different tiers round an open cylinder, and made to pass in a concentrated state through a hollow axis at one end of the cylinder, where it is received on a pulley fastened to a frame that twists the strands into a rope, and on which the strand frames revolve separately in twisting the strands. Each strand passes from these pulleys over another pulley near the centre of the machinery, to a grooved block which revolves with the main frame, on which the strand frames turn round separately. At the place to which the strands converge above this block they are formed into a rope, which is hauled away as it is made, and wound up by machinery. Mr. Chapman remarks that the final effect of this machine is to make a rope on Mr. Balfour's principle. Mr. Walker also describes a plan of making a strand separately, but we must refer the reader to his specification in the *Repertory of Arts*, No. 70, 2d series.

In 1807 Mr. Syeds took out a patent for improvements in ropemaking, but it does not seem to contain any thing practically different from the plan already described, though the combinations of the machinery are different.

In 1807 Messrs. W. and E. W. Chapman took out a patent for a method of making a belt or flat band of two or any greater number of strands of shroud-laid rope placed side by side, so as to form a band of any determinate breadth. These strands, according to Mr. Chapman, should in general be alternately twisted the contrary way to each other, and the yarns the opposite way to the strands. The advantage of this invention consists in this, "that the loss of strength by the combination of these strands into a shroud-laid rope is so considerable that, exclusive of the reduction of length from being twisted into a rope, which is about one-sixth the *strength of two strands*, made in such a way as to make all the yarns bear an equal tension, or nearly so, will, when laid side by side, be nearly *equal to three such strands when combined as a rope.*" Mr. Chapman has also invented a "trunk or frame with its apparatus, for combining speedily and correctly together any requisite number of strands or other flexible substances laid side by side." Mr. Chapman is of opinion, that these belts are stronger than salvages composed of the same number of yarns placed side by side, which Duhamel and others considered to be the strongest combination of yarns.

Description of rope machinery.

Having thus given an account of the leading improvements which have been made in the rope manufacture, we shall now describe one of the best modern machines which is at present in use at the manufactory of the Gourock Rope Company, and for which we have been indebted to Archibald Baine, Esq. the principal partner.

Description of PLATE CCCCLXXXII.

PLATE CCCCLXXXII. Fig. 2—8.

Fig. 2. Exhibits a side elevation of the tackle-board and bobbin-frame at the head of the ropery, and also of the carriage or rope machine in the act of hauling out and twisting the strands.

Fig. 3. Is a plan or bird's-eye view of the same, without the bobbin-frame.

Fig. 4. Is a front elevation of the carriage.

Fig. 5. Is a yarn guide, or board, or plate, with perforated holes for the yarns to pass through before entering the nipper.

Fig. 6. & 7. Are side and front views of the nipper for pressing the rope yarns.

Fig. 2.

Fig. 2. *a* is the frame for containing the yarn bobbins. The yarns are brought from the frame and pass through a yarn guide at *b*. *c* is a small roller under which the ropeyarns pass. They are then brought over the reel *d*, and through another yarn guide *e*, after which they enter the nippers at *v*, and are drawn out and formed into strands by the carriage. The roller and reel may be made to traverse up and down so as to regulate the motion of the yarns.

Fig. 3, 4.

Fig. 3. & 4. being different views of the carriage, the same marks of reference will denote the same parts of both, so far as they are visible. The carriage runs on a railway. *f f* is the frame of the carriage, *g g* are the small wheels on which it is supported, *k k* is an endless rope, reaching from the head to the bottom of the railway, and is driven by a steam engine, *m m* is a wheel with gubs at the back of it, over which the endless rope passes and gives motion to the machinery of the carriage. *n n* is the ground rope for taking out the carriage, as will be afterwards described. On the shaft 2.2 (Fig. 3.) are two bevelled wheels 3.3, with a shifting catch between them; these bevelled wheels are loose upon the shaft, but when the catch is put into either of them, this last then keeps motion with the shaft, while the other runs loose. One of these wheels serves to communicate the twist to the *strand* in drawing out, the other gives the opposite or after-turn to the *rope* in closing. 4 is a lever for shifting the catch accordingly. 5 is a third bevelled wheel, which receives its motion from either of the other two, and communicates the same to the two spur wheels 6.6 by means of the shaft *x*. These can be shifted at pleasure, so that by applying wheels of a greater or lesser number of teeth above and beneath, the twist given to the strands can be increased or diminished accordingly. The upper of these two communicates motion by means of the shaft *o*, to another spur wheel 8, which, working in the three pinions (9) above, gives the twist to the strand hooks.

Fig. 3.

The carriage is drawn out in the following manner. On the end of the shaft 2.2 (Fig. 3.) is the pinion *r*, which, working in the large wheel R, gives motion to the ground rope-shaft *s s*. In the centre of this shaft is a curved pulley or drum *t*, round which the ground rope takes one turn. This rope is fixed at the head and foot of the ropery, so that when the machinery of the carriage is set a-going by the endless rope *k k*, and gives motion to the ground rope-shaft as above described, the carriage will necessarily move along the railway, and the speed may be regulated either by the diameter of the circle formed by the gubs on the wheel *m m*, or by the number of teeth in the pinion *r*. (Fig. 3.) T is a small roller merely for preventing the ground rope from coming up among the machinery. At the head of the rail-way, and under the tackle-board, (Fig. 2.) is a wheel and pinion Z, with a crank for tightening the ground rope. (Fig. 2. connected with Fig. 8.) exhibits the fixed machinery at the head for hardening or tempering the strands. The machinery here is similar to that on the carriage, with the exception of the ground rope gear which is unnecessary. The motion is communicated by another endless rope, (or short band as it is called, to distinguish it from the other,) and passing over gubs at the back of the wheel 1.1.

Fig. 8.

When the strands are drawn out by the carriage to the requisite length, the spur wheels *r* R, (Fig. 3.) are put out of gear. The strands are cut at the tackle-board and fixed to the hooks 1, 1, 1; after which they are hardened or tempered, being twisted at both ends. When this operation is finished, the three are united on the large hook *h*, the top put in, and the rope finished in the usual way.

In preparing the hemp for spinning an ordinary thread of rope yarn, it is only heckled over a large keg or clearer, until the fibres are straighted and separated so as to run freely in the spinning. In this case the hemp is not freed of the tow or cropt, unless it is designed to spin beneath the usual grist, which is about twenty yarns for the strand of a three inch strap-laid rope. The spinning is still performed by hand, being found not only more economical, but also to make a firmer and smoother thread than has yet been effected by machinery. Various ways have been tried of preparing the yarns for tarring. That which seems now to be most generally in use, is to warp the yarns upon the stretch as they are spun. This is accomplished by having a wheel at the foot as well as the head of the walk, so that the men are able to spin both up and down, and also to splice their threads at both ends. By this means they are formed into a haul resembling the warp of a common web, and a little turn is hove into the haul to preserve it from getting foul in the tarring. The advantages of warping from the spinners as above, instead of winding on wenches, as formerly, are, 1st, the saving of this last operation altogether; 2dly, the complete check which the foreman has of the *quantity* of yarn spun in the day; and 3dly, that the *quality* of the work can be subjected to the minutest inspection at any time. In taring the yarn, it is found favourable to the fairness of the strip, to allow it to pass around or under a reel or roller in the bottom of the kettle while boiling, instead of coiling the yarn in by hand. The tar is then so pressed from the yarn by means of a sliding nipper, with a lever over the upper part, and to the end of which the necessary weight is suspended. The usual proportion of tar in ordinary ropes is something less than a fifth. In large strap-laid ropes, which are necessarily subjected to a greater press in the laying of them, the quantity of tar can scarcely exceed a sixth, without injuring the appearance of the rope when laid.

For a long period the manner of laying the yarns into ropes, was by stretching the haul on the rope-ground, parting the number of yarns required for each strand, and twisting the strands at both ends by means of hand-hooks or cranks. It will be obvious that this method, especially in ropes of any considerable size, is attended with serious disadvantages. The strand must ever be very uneven; but the principal disadvantage, and that which gave rise to the many attempts at improvement, was, that the yarns being all the same length before being twisted, it followed when the rope was finished, that while those which occupied the circumference of the strand, were perfectly tight, the centre yarns on the other hand, as they were now greatly slackened by the operation of hardening or twisting the strands, actually would bear little or no part of the strain when the rope was stretched, until the former gave way. The method displayed in the accompanying drawing and description is among the latest and most approved. Every yarn is given out from the bobbin frame as it is required in twisting the rope; and the twist communicated in the outgoing of the carriage, can be increased or diminished at pleasure. In order to obtain a smooth and well-filled strand, it is necessary, also, in passing the yarns through the nipper board, to proportion the number of centre and outside yarns. We know of no arithmetical proportion for ropes of all sizes; but in ordinary sized ropes, the strand seems to have the fairest appearance when the outside yarns form from $\frac{2}{3}$ds to $\frac{3}{4}$ths of the whole quantity in the strand. But the nicest part of the operation is the proportion of twist given by the carriage in drawing out and forming the strands. Were the whole twist necessary, communicated then, and the rope closed without the operation of hardening, the whole strain would bear on the centre yarns when the rope came to be stretched. The object of hardening (that is twisting the strands at both ends before putting in the top to close the rope), seems to be, at once to tighten and *firm* the strand, and also so to ease the centre yarns, as that too much strain may not fall upon them either in closing or afterwards in stretching the rope. We find the twist to be in this proportion when one complete turn of an outside yarn occupies as much space along the strand as the circumference of the *rope* itself when made. This is easily seen by attaching a white thread to an outside yarn before it reaches the nipper. It may be also ascertained by the difference of length between the centre and an outside yarn, taken in connexion with the circumference of the rope; but the former method is the simplest and most satisfactory. It may be remarked also, that this refers to strap-laid ropes only. In hawser, or cant-laid ropes, as they are called, the proportion of twist is fully $\frac{1}{8}$th less. Where this is not attended to, the hawser, or cable, will be found to be stiff and unmanageable. However, it is difficult to give precise arithmetical proportions. The ropemaker should have frequent recourse to experiment, that is, to the examination of the rope after being stretched or used; and as he previously knew the proportion of twist in drawing out, and in hardening, to vary those according to the observations which he makes. In hardening the strands of a strap-laid rope, the carriage usually comes in fully more than one-tenth of the length of the strand. In laying the strands together, it only requires to be attended to, that, while as much after turn is given as is necessary for the right formation of the rope, just so much twist should be communicated to the strands by the forehooks, as will counteract the opposite or after turn. This is easily seen by observing whether the strands before the top, are shortening, or otherwise, while the rope is closing. A chalk mark upon the strand, close by a stake-head, will show this. If this is not attended to, and too much turn given, some of the outside yarns will most probably snap, even in the closing.

The above observations will be in some measure illustrated by the following comparative lengths of yarn, strands, and rope, in two descriptions of rope of most common use.

Thus, to form a three-inch strap laid rope (that is a rope three inches in circumference, and composed of three single strands), 120 fathoms in length.

An outside yarn of the strand, when drawn out by the carriage, and twisted as above will be 174 fathoms long.

The length of each strand, or of the centre yarn before being hardened, - - - -	166
The length of the same, after hardening, and before the top is put in, - - - - -	150
The length of the rope, -	120

Again, to form a hawser or cable, 120 fathoms long, and 6 inches in circumference.

An outside yarn, as above, will be	190 fathoms.
Each of the 9 single strands, before hardening, - -	183
Each of the 9 single strands, after hardening, - -	163
Each of the 3 great strands, when closed, - - -	147½
Each of the 3 grand strands, after hardening, - - -	135½
Length of the cable or hawser,	120 fathoms.

Experiments on Ropes.

It was long ago shewn by Dr. Hooke, from several experiments on the strength of cordage in 1669, that the strength of the component parts of the rope was diminished by twisting. This fact, indeed, has been long practically known to sailors who are familiar with the superior strength of rope yarns when made up into a *salvage*, which is nothing more than a skein without twisting. Salvages are invariably used for slinging great guns, rolling tackles, and for every kind of work where great strength and great pliancy are required.

In the memoirs of the Academy of Sciences for 1711, M. Reaumur has given an account of his experiments on the strength of ropes, compared with that of their parts. The following are some of the most interesting results.

1. A thread of silk, composed of 832 fibres, broke with from five to five and a half pounds. Each fibre sustained one drachm 18 grains. Sum of the absolute strengths of the fibres, 1040 drachms, or 8lbs. 2oz.

Real strength . . .	5 8
Loss of strength by twisting	2lbs.10oz.

2. The yarn of a skein of white thread bore each, at an average . . . . 9¾ lbs.

Two yarns twisted slack into a cord broke with	16
Hence we have the absolute strength of two yarns . . .	19½
Real strength . . .	16
Loss of strength by twisting	3½ lbs.

3. The average strength of some thread was such, that each broke with 8lbs. whereas when *three* were twisted, they bore only . . 17½ lbs.

Hence we have absolute strength .	24
Real strength	17½
Loss of strength by twisting	6½ lbs.

4. The average strength of some thread was such, that each broke with 7½lbs.; whereas when *four* were twisted, they broke with 21½lbs.

Hence we have absolute strength .	30 lbs.
Real strength . . .	21½
Loss of strength by twisting	8½ lbs.

5. The average strength of other four threads was such that each broke with 9lbs. whereas when twisted, they broke with 22lbs.

Hence we have absolute strength .	36 lbs.
Real strength	22
Loss of strength by twisting	14 lbs.

6. A well made and small hempen cord broke in different places with 58, 63, 67, and 72lbs., so that its average strength was $\frac{58 + 63 + 67 + 72}{4} = 65$lbs.

The cord consisted of three strands, and another part of it was untwisted, and its three strands separated. One of them bore 29½, another 33½, and the third 35. Hence the absolute strength of the three strands, when separate, is . . . . 98 lbs.

Real strength when twisted .	65
Loss by twisting	33 lbs.

7. Another part of the same cord, which broke with 78lbs. was separated into its strands, when they bore 26, 28, and 30 pounds.

Hence we have absolute strength .	84 lbs.
Real strength	72
Loss by twisting	12 lbs.

Experiments of Sir C. Knowles.

Dr. Robison has given an account of a very interesting experiment by Sir Charles Knowles, upon a piece of white or untarred rope, 3½ inches in circumference. It was cut into many portions, and from each of those portions a fathom was taken off, and carefully opened out. It consisted of 72 yarns, each of which was examined separately, and found to bear 90lbs. at an average for the whole. Each piece of rope corresponding to these was examined separately, and the mean strength of the same pieces was . 4552 lbs.

Hence we have absolute strength of yarns	6480
Real strength . . .	4552
Loss of strength by twisting	1928 lbs.

As the diminution of strength in the yarns, demonstrated by the preceding example, obviously arises from their position when twisted, in consequence of which they do not all bear the load at the same time; and not from any permanent weakness produced by the twisting it became reasonable to believe, that the twist given to ropes should be as moderate as possible. A slight degree of twist, however, which would give most strength to the rope, would expose it to various accidents which would injure its texture; so that a certain degree of hardness and compactness, which can only be derived from twisting, is absolutely necessary to the perfection of a rope, which ought to be to keep out water to prevent it from rotting.

The degree of twist commonly employed was such that the rope was *two-thirds* the length of the yarns which composed it. M. Duhamel, who made many valuable experiments on this subject, in the royal dock-yards of France, caused some rope to be worked with only *three-fourths* of the length of the yarn. This last rope, with the inferior degree of twist, bore 5187lbs. whereas the other bore only 4321lbs. He next caused these ropes to be made with different twists, and obtained the following results.

Degree of twist.	Weight borne by each.	
	One expt.	Another expt.
$\frac{2}{3}$	4098	4250
$\frac{3}{4}$	4850	6753
$\frac{4}{5}$	6205	7397

So far these experiments were highly satisfactory; but it still remained to be seen, whether or not the ropes which had an inferior degree of twist, had not also an inferior degree of useful solidity, notwithstanding their superiority of strength in carrying weights.

In order to determine this point, M. Duhamel had a considerable quantity of rigging made with yarns, wrought up into only *three-fourths* of their length, and got them put into actual use on ship-board, during a whole campaign. The report given by the officers of the ship was highly satisfactory. They proved that the ropes thus manufactured were *one-fourth* lighter than the common kind;—that they were nearly *one-eighth* more slender, so as to give less hold to the wind; that from their being more pliant than the common ones, they run easier through the blocks, and did not run into what are technically called kinks;—that the new cordage required fewer hands to work it, in the proportion of *two* to *three*; and that it was at least *one-fourth* stronger.

Having obtained such important results, M. Duhamel was led to push his experiments to the very utmost limit, and to try what could be effected by abandoning altogether the process of twisting. He began by laying the yarn in skeins, covering it with a worming or coating of small line. These ropes had *great strength* but *no duration*, because the coating opened at every short bending and was soon rubbed off. He next covered the skeins with a coating woven as is done with ropes used for house furniture; but this required to be put on at great expence, in order to be put on with proper tightness. He also wove some small ropes solid, which turned out very strong, but all these combinations were unfit for service, and became soft and pervious to water.

Wherever ropes, however, are not exposed to short bendings, as in the case of standing rigging, where they can be defended from water by tarring, &c. the least twisted cordage may be advantageously employed, and should, according to M. Duhamel's experiments, be made from strands; for it is demonstrable that in fine stranded cordage, when the twist of the strands is exactly equal to the twist in the laying, the strands lie less obliquely to the axis than in other ropes, and therefore bear a greater load. M. Duhamel made two small hawsers, one of which had three strands and the other six with a heart. The first bore 865, and the other 1325 pounds; and in comparing hawsers with *three* with those with *four* strands, he always found the *four* stranded cordage greatly superior, and he found also that a heart judiciously put in not only rendered the work easier and more perfect to the eye, but also stronger and more durable.

In examining the strength of cordage, 3½ inches of circumference and under, M. Duhamel found that the strength increased a little faster than the number of equal threads, thus:

Ropes of 9 threads bore	1014 instead of	946 lbs.
12	1564	1262
18	2148	1893

According to the experiments of Mr. Huddart, no strength is lost in the common way when there are only three yarns in the strand. When there are three yarns, the loss is one-sixth, and with a hundred yarns it is about one-half. His registered cordage, according to theory, loses nothing, but by actual experiment it loses one-eighth.

The following rule is given by Dr. Robison for obtaining the strength of ropes.

Multiply the circumference of the rope in inches by itself, and the fifth part of the product will be the number of tons which the rope will carry.

For example, if the rope is 6 inches in circumference, we have 6 times 6 = 36, the fifth of which is 7⅕ tons.

There is no branch of the rope manufacture more important than that which relates to the tarring of the cordage. The following experiments were therefore made by M. Duhamel on the relative strength of tarred and white or untarred cordage.

August 8th, 1741.

Untarred Rope.	Tarred Rope.	Difference.
Broke with 4500 pounds.	3400 pounds.	1100
4900	3300	1600
4800	3250	1650

April 25th, 1743.

Untarred Rope.	Tarred Rope.	Difference.
Broke with 4600 pounds.	3500 pounds.	1100
5000	3400	1600
5000	3100	1900

Sept. 3d, 1746.

Untarred Rope.	Tarred Rope.	Difference.
Broke with 3800 pounds.	3000 pounds.	800
4000	2700	1300
4200	2800	1400

The ropes with which the preceding experiments were made, were three French inches in circumference, and were made of the best Riga hemp.

M. Duhamel next examined the relative strength of a parcel of tarred and untarred cordage, which had been manufactured on the 12th of July, 1746. It had been laid up in the storehouse, and the following results were obtained at the dates mentioned.

	Difference of time in Months.	Untarred Rope.	Tarred Rope.	Diff.
1746 April 14th,		2645 pounds.	2312 pounds.	333
1747 May 18th,	11	1762	2155	607
1747 Oct. 21st,	6	2710	2050	660
1748 June 19th	9	2575	1752	823
1748 Oct. 2d,	4	2425	1837	588
1749 Sept. 25th,	12	2917	1865	1052

From these results M. Duhamel concludes, 1. That *untarred cordage* in constant service is *one-third* more durable than the same cordage when tarred.

2. That *untarred cordage* retains its strength for a much longer time when it is kept in store.

3. That *untarred cordage* resists the ordinary injuries of the weather *one-fourth* longer than when it is tarred.

These results of direct experiments have been confirmed by the observations of seamen; but they have invariably found, that untarred cordage is weaker than tarred cordage, when it is exposed to be alternately wet and dry; that tarred cordage is chiefly useful for cables and ground tackle, which must be constantly soaked in water; and that cordage, *superficially tarred*, is always stronger than what is thoroughly tarred, and resists better the alternate conditions of dryness and wetness.

Several important experiments on the relative strength of tarred and untarred ropes were made by Mr. W. Chapman, chiefly with the view of determining the effects of his method of preserving ropes with purified or washed tar. Three pieces of rope were made on the 10th August, 1808, of 12 threads in each strand. The first was an untarred rope, the second a rope made of washed tarred yarn, and the third a common tarred rope. A part of each of these ropes had their strength tried on the breaking machine; and another part was steeped in water for about three months, and then taken to a foundry stove, which is supposed to have been at about 130° of Fahrenheit. They remained in the stove about three months. After that they lay at Mr. Chapman's ropery till Nov. 3d, 1803, when the following experiments were made with them:

	When made, Aug. 10th, 1802.	Nov. 3d, 1803.	Portion of original Strength retained.
	Cwt.	Cwt.	Cwt.
White rope . : .	33.4	1.9	5.7
Common tarred rope	22.2	7.35	33.0 pr. cent.
Washed tarred rope	29.1	12.35	43.8

The tarred ropes were both brittle; but the latter was more so, and they both cracked on bending.

The following experiments were made, in 1807, by Mr. Chapman, for the purpose of showing the injury arising from the retention of that portion of the essential oil which cannot be dispensed with, and also the injury which arises from the progressive disengagement of the acid of essential oil.

	Weight with which it broke when Moist.	Weight with which it broke after exposure to a Stove for four Months.
	Cwt.	Cwt.
Untarred rope	45.75	38.97
Rope tarred with cold tar .	51.29	26.40
Do. with boiled tar .	38.94	25.07

The first column shows the strength of the rope when made; and the second after having been exposed to the heat of a stove from 85° to 100° of Fahr.

The following experiments also made by Mr. Chapman, confirm those of Duhamel, respecting the diminution in the strength of cordage produced by tarring. The ropes were registered on the improved principle, and were made with the same yarn, and with 17 threads in each strand.

Rope-making.

			Comparative Strength.
	Inch.	Cwt.	Cwt.
1806, Oct. 2d, White rope, girt	2.75	broke with 75	100
Oct. 24, Tarred rope,	2.8	55	73.3
1807, May 8, Same rope,	2.8	41.4	55.2

The following experiments were made with ropes made of the same yarns, and of nine in each strand.

	Girt in Inches.		Comparative Strength.
	Cwt.	Cwt.	Cwt.
White rope . . .	1.7	Broke with 27.5	100
Tar of whale oil . .	1.85	22.5	88.7
Tar and tallow . .	1.8	17.5	63.6
Tar unpurified . .	1.7	15.95	57.7

Whale oil and tallow have therefore an excellent effect, particularly the former.

Strength of ropes of long wool.

The following results, obtained by Mr. Chapman, show the progressive weight borne by a rope made of *long wool*, and the elongation which the different lengths sustained by these weights.

	Length of Pieces when Loaded.	Length when Unloaded.
Lightly stretched.	24 inches.	
1.65 cwts.	26¼	
3.3	29	27
3.85	31	28
4.95	31½	29½
6.05	37	32
7.15	37¼	
7.7	Rope broke.	

When the rope broke, its length returned to 26½ inches, though in a former trial it stood at 32 inches. The girt of the woollen rope was 1.8 inches, and it weighed 75 lbs for every 120 fathoms. Mr. Chapman computes, that woollen ropes may be about ⅓d of the strength of good hempen ones, and ⅔ds the strength of common white ones.

Elasticity of ropes.

The following experiments were made by Mr. Chapman on the elasticity of ropes of different kinds, when strained with ⅞ths of their breaking stress.

	Unequal Length	Length when Strained.
Registered primary strands	24 inches	24¾ to 25 inches.
Registered shroud laid ropes	24	26 to 26½
Common made shroud laid rope	24	27½ to 28
Registered cable laid rope	24	27 to 27½.

The three kinds of rope last mentioned, stretched on an average 1 inch in 24 with a fifth of their breaking stress, which is from ½ to $\frac{6}{7}$ lbs. of the whole stretching of the registered strand laid ropes, but only from $\frac{6}{7}$ths to ¼th of the stretching of the common made shroud ropes.

In May 1805, Sir Joseph Banks being anxious to try teak tar for ropes, two three-inch ropes were made of the same yarns, one with teak tar, and the other with common tar. They were then placed in the same storehouse, and were broken Sept. 28th, 1807.

Common tarred rope broke with 3848 pounds.

That made with teak tar broke with 5980

The common tarred rope being only about *two-thirds* the strength of the other.

Having already, in our article Mechanics, Vol. XIII.

Rope-making.

p. 598, given a full account of the experiments of Desaguliers, and of the more recent and accurate ones of Coulomb, *On the Friction and Rigidity of Ropes*, we shall conclude this article with two useful Tables, containing the length and weight of ropes and cables of different kinds and sizes.

Table I.—*Shewing the number of fathoms and feet in a hundred weight of rope of any size under* 14 *inches.*

Inches in Circumference.	Fathoms in a Cwt.			Inches in Circumference.	Fathoms in a Cwt.			Inches in Circumference.	Fathoms in a Cwt.		
	Fat.	Ft.	In.		Fath.	Ft.	In.		Fath.	Ft.	In.
1	486	0	0	5½	16	1	0	10	4	5	0
1¼	313	3	0	5¾	14	4	6	10¼	4	4	1
1½	216	0	0	6	13	3	0	10½	4	2	
1¾	159	3	0	6¼	12	2	0	10¾	4	1	
2	124	3	0	6½	11	3	0	11	4	0	
2¼	96	2	0	6¾	10	4	0	11¼	3	5	
2½	77	3	0	7	9	5	6	11½	3	4	
2¾	65	4	0	7¼	9	1	6	11¾	3	3	
3	54	0	0	7½	8	4	0	12	3	2	
3¼	45	5	2	7¾	8	3	6	12¼	3	2	
3½	39	3	0	8	7	3	6	12½	3	2	
3¾	34	3	9	8¼	7	0	8	12¾	2	7	
4	30	1	6	8½	6	4	3	13	2	5	
4¼	26	5	3	8¾	6	2	1	13¼	2	4	
4½	24	0	0	9	6	0	0	13½	2	4	
4¾	21	3	0	9¼	5	4	0	13¾	2	3	
5	19	3	0	9½	5	2	0	14	2	2	
5¼	17	4	0	9¾	5	0	6				

Table II.—*Shewing the weight of* 120 *fathoms of any cable or rope for every half inch of circumference, from* 3 *to* 24 *inches.*

Inches in Circumference.	Weight.		Inches in Circumference.	Weight.		Inches in Circumference.	Weight.	
	Cwts.	Qrs.		Cwts.	Qrs.		Cwts.	Qrs.
3	2	1	10½	27	2	17½	76	1
3½	4	0	11	30	1	18	81	0
4	4	1	11½	33	0	18½	85	2
4½	5	0	12	36	0	19	90	1
5	5	1	12½	39	0	19½	95	0
5½	7	0	13	42	1	20	100	0
6	9	0	13½	45	7	20½	105	0
6½	10	2	14	49	0	21	110	1
7	10	1	14½	52	2	21½	115	2
7½	14	0	15	56	1	22	121	0
8	16	0	15½	60	0	22½	126	2
8½	18	0	16	64	0	23	132	1
9	20	1	16½	68	0	23½	138	0
9½	22	2	17	72	1	24	144	0
10	25	0						

Those who wish for farther information on the subject of ropemaking, are referred to the following works:

Dr. Hooke, in Birch's *Hist. of Royal Society*, vol. ii. p. 393. Depontis, *Id.* 1739, *Hist.* p. 56. M. Duhamel's *Traité de la Corderie perfectionnée*, 4to. Dr. Robison, *Encycl. Brit.* art. Ropemaking. Mr. Balfour's patent of 1793, *Repertory of Arts*, 1st series, vol. ii. p. 145. Mr. Huddart's patent of 1793, *Repertory of Arts*, 2d series, vol. iv. p. 81. Mr. Chapman's patent of March 1798, *Repertory of Arts*, 1st series, vol. ix. Mr. Chapman's patent of Nov. 1798, *Repertory of Arts*. Mr. Curr's patent for flat ropes, *Repertory of Arts*, 1st series, vol. x. p. 361. Mr. Mitchell's patent of 1799, in the *Repertory of Arts*, 1st series, vol. xi. p. 302. Mr. Huddart's patent of August 1799, *Repertory of Arts*, 1st series vol. xii. Mr. Huddart's patent of July 1800, *Repertory of Arts*, 1st series, vol. xiv. Messrs. Mitchell's patent of 1802, *Repertory of Arts*, 2d series, vol. viii. p. 241. Mr. Walker's patent of 1806, *Repertory of Arts*, 2d series, No. 70. Huddart's *Remarks on the Patent Registered Cordage*, Lond. 1800. Mr. Chapman's *Treatise on the progressive endeavours to improve the Manufacture and Duration of Cordage*, Lond. 1808.

Rope Machine. Rosa. Salvator.

ROPE MACHINE. See HYDRODYNAMICS, Vol. XI. p. 566.

ROSA, MONTE, a short account of this celebrated mountain has already been given in our article ALPS, Vol. I. p. 581. Monte Rosa is the highest mountain in Europe excepting Mont Blanc. From a mean of various measures taken with accuracy, the height of Mont Blanc is 2461.8 toises, while that of Monte Rosa is 2373, whence it appears that Mont Blanc is only 88 toises higher than Monte Rosa. Monte Rosa was called by the ancients Mons Sylvius. The name of Monte Rosa seems to have been first given to it by Scheuchzer, in his *Itinera Alpina*, in 1702—1711: and Baron Welden thinks that it derives its name from the roseate tints which the first rays of the rising sun throws on its whitened summits.

The summit of Monte Rosa has not yet been reached by any traveller. One Maynard pretended that he had accomplished this on the 13th August, 1813; but his own account shows, that the point which he reached was very far from the summit. Professor Parrot of Dorpat, and M. Zumstein of Gressonay, made two attempts in 1817, to ascend the highest peak; but they failed in both. In 1819, M. Zumstein ascended one of its southern summits.* He made a second ascent in August 1820, a third in August 1821, and a fourth and fifth in July and August 1822.

The following is a Table of the heights of the different peaks of Monte Rosa.

			Paris Feet.
Monte Rosa,	1st, or highest	peak	14,222
	2d	peak	14,154
	3d	peak	14,028
	4th	peak	12,984
	5th	peak	13,650
	6th	peak	12,984

Baron Welden, an enterprising German traveller, conceived the design of exploring and describing the topography, the orometry, the geology, the natural history, and the botany of this mountain; and he has executed this design with great ability in his work, entitled *Der Monte Rosa. Eine Topographische und Naturhistorische Skizze nebst einem Anhange der Von Herrn Zumstein, gemachten Reisen zur Ersteigung seiner Gipfel*, Vienna, 1824. This work is accompanied with a topographical chart of Monte Rosa and its environs, on a scale of 3200 toises to a Paris inch, with a map of the trigonometrical operations among the Alps, and five lithographic views taken by the camera lucida from the Lago D'orte, from Turin, from Vercelli, from Gemmi, and from Rothorn. Besides giving an account of the glaciers, torrents, rivers, and line of perpetual snow on the mountain, Baron Welden has given a very interesting account of the inhabitants of the adjacent valleys,—a German population of 9000 persons, who have preserved their language and customs entire. He has also added, as the title of the book expresses, an account of M. Zumstein's ascents. See Dr. Brewster's *Journal of Science*, vol. i. No. i. and vol. ii. p. 152.

ROSA, SALVATOR, a celebrated painter, was born at Naples in 1614. He received his first lessons in painting from his kinsman, Francisco Francazani; but having been left in poor circumstances by the death of his father, he was obliged to dispose of his sketches at any price which they would bring. A historical sketch of Hagar and Ishmael, executed under these circumstances, fell into the hands of Lafranc, who generously took him under his protection, and contrived not only to place him in the school of Spagnoletto, but to procure him the instructions of Daniel Falcone, a celebrated battle painter at Naples. Under these favourable circumstances, Salvator pursued his studies with singular success, and speedily rose to great eminence as an artist. He is said to have spent his early life among a horde of banditti, and to have thus acquired a knowledge of that wildness both of scenery and character which marks most of his pictures. The character of his works, as given by Sir Joshua Reynolds, has already appeared in our article PAINTING, Vol. XVI. p. 241.

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* An account of this ascent will be found in Dr. Brewster's *Journal of Science*, vol. i. p. 1.

Salvator was also known as a good satyrical poet, and, though coarse and rough, his poetry is said to be marked with the same boldness and originality which characterise the productions of his pencil. He was also celebrated for his musical composition, specimens of which will be found in the 4th volume of Dr. Burney's *General History of Music.* Salvator Rosa died at Rome in the year 1673, in the 59th year of his age, and he was buried in the church of Santa Maria degli Angeli de P. P. Certorini, where a tomb is erected to his memory. Salvator is likewise celebrated for numerous etchings, principally historical. One of his best pictures is that of Saul and the Witch of Endor, preserved at Versailles.

ROSARY. See HORTICULTURE, Vol. XI. p. 303.

ROSCOMMON, in geography, an inland county of Ireland, in the province of Connaught. It is bounded by the river Shannon for its whole length on the east, and this fine river separates it from Leitrim, Longford, Westmeath, and the King's County; on the south-west it is bounded by the Suck, which separates it for most of its course from Galway; on the north-west it is bounded by the counties of Mayo and Sligo.

By Messrs. Edgeworth and Griffith's late minute survey, it appears that the area measures 368,868 Irish acres.

Its length from north to south is 47 Irish miles, and its breadth varies from 12 miles to 30½.

There are six baronies in this county, and 56 parishes. The population by the last census is 207,000. It is very thickly inhabited between Lanesborough and Strokestown, and north of Lough Key, and in general in the neighbourhood of the bogs and mountains.

The tillage is rapidly increasing, from the extension of the royal canal and the improvement of the roads; and the pastures are famous for their luxuriance, particularly between Boyle and Elphin, where there is a tract of country called the Plains of Boyle; but which is far from being flat.

The interior of the country is chiefly limestone, and the soil so rich, that it lets at from three to four guineas an acre. The fields are generally divided by stone walls.

To the north, the mountains, if they can be so called, are near 1000 feet high, and in these veins of coal are worked with some vigour. Lines of railroad are already laid out by the assistance of government; and it is likely that a company will carry on the collieries here and in Leitrim to such an extent, as not only to supply the neighbourhood with fuel, but the town of Sligo on the coast, which is sixteen miles distance.

The valley of the Arigna is rich with iron ore, which was worked about thirty years ago; but, from mismanagement, the Arigna iron works have fallen into ruin. But a new company are now (1824) commencing operations. Roscommon is the shire or county town, Boyle, Strokestown, Elphin, Castlerea, and French Park, are towns of some importance.

It is to be regretted, that amongst the number of beautiful county maps that have been made in Ireland, so few have been constructed on scientific principles. We find diagrams of triangles attached only to the maps of the county of Dublin by Mr. Duncan; the county of Mayo by Mr. Bald; the county of Longford, and this county, that part of which, north of the road from Lanesborough, through Roscommon to Ballyneve, was by Mr. William Edgeworth.

ROSCOMMON, WENTWORTH DILLON, EARL OF, a poet of considerable celebrity in the 17th century, was the son of James Dillon, Earl of Roscommon, and was born in Ireland. He received a classical education under Dr. Hall, bishop of Norwich, and having completed his education at Caen in Normandy, he went to Rome, where he studied the venerable remains of antiquity in that capital, and acquired a thorough knowledge of the Italian language. He was made Captain of the band of Pensioners soon after the Restoration, but he soon resigned that post. He was afterwards made Master of the Horse to the Duchess of York, and married the eldest daughter of the Earl of Burleigh. Roscommon now distinguished himself by his writings. He composed several poems, which may be found in the body of English Poetry, collected by Dr. Johnson. His translation of Horace's *Art of Poetry*, and his *Essay on Translated Verse*, have acquired him the reputation of a good writer and an elegant poet. To these qualities he added the more estimable ones of modesty and goodness; and he has been characterised by Pope as the only moral writer of the reign of Charles II. In 1683 he was attacked with the gout; but having taken a violent medicine from a French empiric, the disease was driven into his bowels, and he died in January 1684. His remains were interred with great pomp in Westminster Abbey.

ROSE. See BOTANY and HORTICULTURE, vol. XI. p. 290 and 303.

ROSE ENGINE. See TURNING.

ROSEMARY. See HORTICULTURE, Vol. XI. page 281.

ROSETTA, or RASCHID, a considerable town of Egypt, situated on the canal of Rosetta, anciently the *Balbitinum*, one of the two great channels by which the Nile delivers it waters into the Mediterranean. Rosetta was built about the year 870 A.D. Even so late as the 13th century, it was a place of little importance; yet when the other canal ceased to become navigable, Rosetta became, in the 16th century, the emporium of the merchandise of Alexandria and Cairo. It is now one of the handsomest towns in Egypt, extending about a league in length, by a quarter of a mile in breadth, along the western bank of the Nile. Although the streets are not regular, and are very narrow, not more than two yards, according to Sir Robert Wilson, each successive story of the houses projecting over the one below, so as to give a gloomy appearance to the town, yet the town has an agreeable appearance in comparison with Eastern cities. The houses are

Rosetta, Roslin.

built of a dingy red brick, while all the mosques, minarets, and chief houses, are plastered and white-washed. These mosques and minarets are the principal public buildings; and as the houses have flat roofs, they appear to more advantage, overtopping them with their bold and picturesque architecture. The environs of the town have been long celebrated. Groves of date, banana, sycamore, the palm, and other trees, surround it on all sides; and the orange, the lemon, the pomegranate, and the pear trees, contribute their beauties and perfume to the city. The garden of Egypt, as it is called, viz. the richest part of the Delta, is seen on the opposite side of the Nile, clothed with vegetation.

The chief article of cultivation near Rosetta is rue, which is one of the principal articles of export. Among the branches of commerce peculiar to the town, are spices, cotton dyed red, brought from the adjacent districts, dressed flax, linen clothes, silk dies. There are store houses of natron in Rosetta. The quay is handsome and well built; population about 9000. East longitude 30° 28′ 20.″ North latitude 31° 25′ 0.″ See the Travels of Savary, Sonini, and Niebuhr.

ROSLIN, the name of a very small and ugly village in the county of Midlothian, celebrated for the beauty of the scenery in its neighbourhood, and for the castle and chapel of Roslin. The castle stands on a bold and lofty rock, rising from the banks of the North Esk, which here makes a rapid turn, dashing over its rugged bed round the base of the castle. The entrance to the castle is by a narrow bridge, over a deep dell, which is beautifully wooded, and gives a fine aspect to the masses of ruined wall of which the castle now consists. A comparatively modern building, which is sometimes inhabited, is erected in the middle of the castle, but it possesses a sufficiently ancient character to harmonize with the adjacent ruins.

The chapel occupies the summit of a hill above the castle. It was founded in 1446, by William Saint Clair, Earl of Caithness and Orkney, who "causd artificers to be brought from other regions and forraigne kingdomes, and causd dayly to be abundance of all kinde of workmen present.*** and to the end the worke might be more rare, he causd the draughts to be drawn upon Eastland boords, and made the carpenters to carve them according to the draught, and then gave them for patterns to the masons, that they might thereby cut the like on stone."* The architecture of this chapel is exceedingly beautiful and highly ornamented; and, according to Mr. Gandy, it unites the Egyptian, Grecian, Roman, and Saracenian styles," and exhibits the arch "in all its possible forms and principles;" there being, according to Mr. Britton, thirteen varieties. The chapel is 69 feet long inside, 34 broad, and 40 high. The vaulted and highly decorated roof is supported by two rows of clustered columns, eight feet high, having the capitals encircled with foliage and various figures representing scenes of Scripture history. The building is supported on the outside by 21 buttresses.

Immediately above Roslin Castle, on the river side, is an extensive bleachfield; and a little above this the powder mills of Eskhill.

The uncommon beauty of the scenery on the North Esk, from Roslin Castle to Hawthornden and Lasswade, makes it a place of great resort in summer, the distance of Roslin from Edinburgh being only seven miles. See our article Civil Architecture, Vol. VI. p. 559, Col. 2; and *Mid*-Lothian. See also the *Statistical account of Scotland*. The *Beauties of Scotland*; and Britton's *Architectural Antiquities of Great Britain*, Vol. III.

ROSS, the name of a burgh and market town of England in Herefordshire, is delightfully situated on a rock on the east bank of the river Wye. The streets, which are extremely narrow, are chiefly upon a declivity, and the houses have the appearance of being huddled upon each other. The church, which is handsome, has a lofty spire at its west end; and it contains the remains of the benevolent man of Ross, Mr. John Kyrle, who served the office of sheriff of the county in 1683, and was celebrated for his beneficence and charities, though his income did not exceed £500 a year. The market house, built of stone, is in a very decayed state, though no older than the time of Charles II.

There are here two charity schools and an almshouse, to both of which Mr. Kyrle contributed liberally. Five iron works of considerable extent have been established near the town, but it is principally celebrated for the sale of cyder and wool; and has become a place of great resort to the admirers of the picturesque, who visit the beauties of the Wye, boats being kept there for the purpose. Number of houses 521, population 2347. See the *Beauties of England and Wales*, Vol. VI.; and King's *Munimenta Antiqua*, Vol. III.

ROSS, New. See Wexford.

ROSS-SHIRE, one of the northern counties of Scotland, extends across the island. On the east coast it terminates in a point; but extends along the western side about sixty miles directly north and south. This county is deeply indented by arms of the sea; and, on the west coast, these are surrounded by high mountains. The aspect of the whole, except a small portion on the east side, is mountainous; there being numerous glens and straths, but scarcely any thing that can be called a valley. The most northern point of this county on the mainland is in latitude 58° 30′, and the most southern in 57° and somewhat more. The numbers are not given as accurate, nor have the extremes of longitude been correctly ascertained, though they are nearly 3° 30′ and 5° 30′. The great triangles of the ordnance having been completed, it would be useful to publish them on a moderate scale; and it is not probable that we shall know more than we now do of the geography of our country until the ordnance maps are completed.

The number of square geographical miles contained in Ross-shire is nearly 2427½, of which the interspersed parts of Cromarty-shire form 240. The old county of Cromarty contains only 18½. The island of Lewis belongs to Ross-shire, and contains 431 square miles.

The number of English acres in the main land is about 2,071,466; in the Lewis 359,093. Of the first number, 220,586 belong to Cromartyshire, and 5973 to Ferrintosh, which is part of the county of Nairn.

The county of Cromarty, so much interspersed in Ross, is now included in the latter for all purposes of police. Both counties are under the jurisdiction of one sheriff, but each has a lord lieutenant. The vulgar divisions of Ross are, 1st, East Ross, the country of the Rosses; 2d, Fearndonald, the country of the Munroes; 3d, West Ross and the Highlands, the country of the Mackenzies. The Black Isle, that peninsula which includes the old county of Cromarty and Ferrintosh is another division, which is part of the Mackenzie country.

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* Memoir of the House of Douglas, in the Advocates Library.

The two counties contain 37 parishes.

ins.

The mountains in this county are for the most part in groups, and some are detached. Many of them reach a considerable elevation, but their heights are not exactly known. There are several mountains on the west coast, which appear to equal it in height, but Ben Wyves, or Nish, (the Mountain of Mist) is esteemed the highest. It is the most remarkable on the east coast, and is about 3600 feet high. Its shape is round-backed, and it is placed between two lower mountains, and, viewed from the south, they have the appearance of supporters or wings. It is very precipitous on all sides but the south; but it is inferior in picturesque beauty to the mountains on the west, the outlines of which are finely varied. Almost the whole west coast abounds in magnificent scenery. That of Loch Carron, Lochalsh, and Loch Duich, is not surpassed, and scarcely equalled by any scenery in Scotland. There are some mountain scenery in the interior very picturesque, and we have seldom seen a finer outline than that which is seen from Coul, the seat of Sir G. S. Mackenzie, Bart. where the low country ends and the highlands begin.

The principal rivers on the east side of the county are the Conon, which flows into the Cromarty Firth, and the Oikel and the Carron flowing into the Dornoch Firth. The largest river on the west coast is the Ewe, which has a short course from Loch Maree. The Conon, and its principal branch the Ranay or Black Water, form some falls of considerable height and beauty. The stream called Altgrad, which flows into the Cromarty firth near Balcomy, has worn down a conglomerate rock to a great depth, for an extent of nearly two miles. The cleft is very narrow, and so deep that the water can be seen only at a few places. Some of the western rivers flow through deep crevices.

The largest lake in Ross-shire is Loch Maree, extending 12 miles in length. It is of unequal breadth, and when broadest is crowded with islands. Loch Tannish is the next in size, placed in the centre of the county, and in the midst of bleak scenery. There are numerous lakes of moderate dimensions, and some of them very prettily situated amidst rock and wood.

The natural forests, which were once extensive, have disappeared almost entirely, excepting the birch and some oaks in different parts of the county. The birch is fast disappearing, on account of the demand for herring barrel staves. But when the birch is cut close to the ground in the months of May and June, it throws out fine shoots and grows as coppice. The remains of fir woods are extensive, and we have yet remaining the trunks of oaks of immense size. The rivers and some lakes contain the remains of very large trees. Plantations are very extensive, and additions are made to them every year.

The climate is very unsteady, so that the horticulturist meets with frequent disappointments. The west coast is subject to much rain. In general, garden produce is about a fortnight later than it is near Edinburgh; but harvest not so much. It has been doubted by many that the climate has become worse than it was; but that such is the case is quite true. Of late years the winters have been open, and the summers late and colder than before, as has been proved by the degree of ripeness acquired by certain fruits, as well as by the thermometer. The indications of this instrument, however, cannot be so well relied on, if the mean temperature only be attended to; for in the northern parts of Scotland, even in seasons that are bad, there may be some weeks of very hot weather, while the rest of the year is cold and dark. It is the want of sunshine that renders a climate inferior in regard to agriculture; and sudden transitions from heat to cold render ours unfavourable, while the mean temperature may appear nearly steady; and thus has arisen a deception that has caused the deterioration of the climate during the last thirty years to be disputed. Besides what has already been stated, the winters have become very mild and open; and this has its influence on account of mean temperature. The fact is, that summer heat has been less, both in amount and duration, since the year 1800, although some few seasons have been favourable; and this holds true for the climate of Great Britain.

Soil.

The portion of this large county capable of cultivation is very small. The arable lands extend along the eastern coast, and are found in patches of small extent here and there on the western. The whole mountainous interior is heath, moss, and rock; but the whole of it affords excellent pasturage for sheep and black cattle. A great proportion of the low land of Eastern Ross, and a small proportion of the land near Dingwall is loamy clay—which is not so heavy as the carse lands in the south, but equally productive. The rest is light soil of various quality. The whole is in the finest state of cultivation.

Minerals.

The mineralogy of this county is little known, though it presents geological features of high interest. Many of the straths present the diluvium in terraces; and similar terraces are to be found along the sea coast, affording ample scope for exercise in those speculations which have become so interesting since the publication of Professor Buckland's work. A remarkable variety of gneiss occurs in the county, enormous blocks of which are found, along with other varieties, scattered over the secondary country; and it is so remarkable in its appearance and structure as to admit of its being traced to the rock from whence it was broken. This has been done, and the distance to which blocks containing a thousand cubic feet and upwards have been carried, has been ascertained to be in a straight line no less than forty miles. We trust that the investigation of the diluvium in this quarter will lead to important conclusions, such as will settle many of the points now in dispute among philosophers.

The strata in which the bituminous coal of Sutherlandshire is found, stretch south and west, and are seen at low water to the north of the entrance of Cromarty firth, and towards Rosemarkie. Only one bed of the coal has been seen, about four inches thick. On each side of the entrance of Cromarty firth, a mass of primitive rocks of small extent rises in a singular manner, the gneiss being mixed with veins of granite and quartz, so as almost to render it uncertain which has been the invading rock. Along the coast towards Fortrose, veins of beautiful white compact felspar are seen, so much resembling marble as to deceive till they are touched by the hammer. The separation of the secondary from the primitive country, is in a line extending from near the hill of Struy to the Dornoch firth, nearly south west. Bituminous limestone occurs in the sandstone near Geanies, and at Cromarty. The bed near the latter place is seen most distinctly on the north side of the firth eastward from the Torryhouse; and is remarkable, on account of its consisting of layers of two or three inches thick, bent at sharp angles, as if a force had been applied longitudinally. The sandstone occurs red and yellow; but it seems to belong to one formation. Near Geanies there appears a very remarkable fracture of the strata, those on the coast having been elevated about two hundred feet from those appearing in the sea. Some very interesting facts appear at this place, but we have not room to describe them here. On looking at the map of Scotland, the eye is at once struck with the remarkable line stretching from Tarbet Ness towards Fort William, in the direction of the Great Canal. It will be interesting to attempt tracing the production of this singular feature, and the formation of the lakes to one cause.

Before we reach the primitive rock on this side of the county, we meet with detached hills on which we notice an immense bed of conglomerate, containing sometimes very large blocks. The whole mass is of primitive origin, a fact that will afford ample scope for discussion when the formation of this rock is contemplated. It is the newest rock of this county, and is seen, after interruptions of various extent, in almost every corner of Scotland. It is seen at considerable elevations, and as it rises towards the north-west, it will probably be found at a great height in the interior. Indeed, the writer of this article recollects having seen it at an elevation of nearly two thousand feet, though he had not an opportunity of examining the rock; and it is not improbable that it may be found capping the high mountains of red sandstone on the west coast. There is not a rock within the whole range of geology that is so interesting as this; and much time will not elapse before it will become the means of proving beyond dispute that although the earth was in a state of chaos previous to the creation of man, it has more than once been under the reforming hand of Almighty power, producing order out of confusion—beauty out of deformity, and giving to old materials the form and properties of that which is new.

On proceeding westward, we find the secondary rocks resting on gneiss but not conformable to it; a fact which proves that the elevated angle of the secondary rocks, has not been caused either by the elevation of the gneiss, or by its position. This has been fully proved indeed by the appearance of a block of gneiss, in the conglomerate rock, traversed by a granite vein. This was observed by Mr. Lyall near Coul, last year, in company with Sir George Mackenzie and Professor Buckland, and he remarked that this was a most distinct proof that the gneiss had been invaded by the granite, and brought to its present position before the formation of the rock in which this block was observed. This observation of Mr. Lyall will lead to new views of the formation and elevation of the secondary rocks, but into which we cannot enter, without swelling our article to an unreasonable bulk.

The junction of the primitive and secondary rocks on the western side of the county has not been observed. Greenstone occurs there in beds among the secondary rocks, as near Applecross, and in veins cutting the primitive rocks, as in Kintail. There are many curious facts in this quarter that seem likely to change the present order in which rocks are arranged. From the position in which mica slate has been found, it would appear to be under the gneiss. It is probable that the distinction between these two rocks may not long continue.

Limestone occurs abundantly on the west coast; and it is said that roofing slate has been observed, but the locality is not known to us.

No large mass of granite has hitherto been observed; but the primitive country is much intersected by veins of granite of many varieties. Bitumen has been found in gneiss in several places, and many years ago a considerable quantity was found near Carthland, and used as fuel. The writer of this article found a small quantity above Brea on the north side of Strathpeffer, and about three miles from the above locality, nearly twenty-five years ago. This is mentioned because it has been recently announced as a new discovery.

Copper pyrites was found in a considerable mass near Kishorn on the west side, and worked for a considerable time. The accumulation of water in the pit prevents its now from being explored. A vein of heavy spar appearing on the north shore of Loch Maree, tempted some persons to mine into the rock, but after having followed it a little way, it was abandoned.

Many of the proprietors of Ross-shire inhabit mansion-houses of considerable elegance; but there is little, if any thing, to praise in their architecture. Some of the seats are well placed, and the grounds about them ornamented by plantations and shrubberies. Around many of them are found noble trees of every variety. At Castlelaud there is a sweet chesnut tree of great size, the diameter of the trunk, five feet from the ground, being six feet, and where the branches separate the thickness is much greater. At the side of the great road leading to the west coast near Kinloch Luichart, are the remains of very large oak trees, and one trunk in particular, lying on its side, has belonged to a tree much exceeding the great chesnut in dimensions. The houses of the principal farmers are neat and commodious. Of late years a very great improvement has been visible in the cottages of the peasantry; but much yet remains to be done. The clergy are particularly well accommodated.

The improvement of the roads in this county has advanced with rapid strides, since government saw the importance of easy communications being afforded to the Highlands, and obtained liberal assistance from Parliament. The proprietors defrayed one half of the expense. The bridges are neat and well built. That across the Conon river consists of five arches; but, in the opinion of many, the top of the parapet, forming a segment of a circle, does not please the eye. The iron bridge at Bonar, across the Dornoch firth, where it is so narrow as to resemble a small river, has little merit in respect to appearance, though it is most substantial and most useful.

There are three royal burghs in this county, Dingwall, Tain, and Fortrose; and it were perhaps better for their prosperity had they not the privilege of voting for a representative in Parliament. There are no manufactories in any of them; and their chief support is the litigious spirit of the people, giving employment to a host of practitioners before the Sheriff Courts. The police is extremely bad, if in any respect effective, both as it regards the towns and the county; and the increase of crime is not much heard of, because little effort is made to check it.

Cromarty is a thriving town. It once was a royal burgh, but the inhabitants petitioned for being deprived of their privileges. It possesses a good harbour, and the roadstead is noted as the safest in all Britain. A considerable manufacture of hemp into canvass for bagging, &c. has been long established, and employs a great number of hands. Curing pork is carried on to a large extent. A canal was cut some years ago from the mouth of the river Conan to Dingwall, in order to facilitate the exportation of grain, and the importation of coals, lime, and goods. The principles on which it was constructed, though very able engineers were employed, were however erroneous, and the consequence has been that it became filled with mud. It has been once cleaned at a great expense, but, what appears most extraordinary, no steps were taken to prevent a recurrence of the evil, and it is again nearly useless.

There are numerous villages in Ross and Cromarty shire; but almost every proprietor who has feued land for building has repented. When there is no regular employment for it, it is baneful to accumulate population into villages. Idleness, vice, distress, and crime, give too frequent evidence that, when there is no fixed employment, population should not be too rashly encouraged. No improvement can be forced; but must depend on an extensive combination of circumstances, which it requires talent and meditation to discover. At this moment a great revolution is taking place, owing to the liberal view which the government has taken of the distillery. The effects of this revolution will be the emigration of the remaining Highlanders who have hitherto subsisted solely on the profits of illicit distillation, scanty as they were; or they will seek subsistence from honest labour wherever they can find employment at home; or attend more closely to the produce of such land as they may possess on lease. It is probable that all these effects may take place, and that point of civilisation and improvement to which we have been tending since the rebellion in 1745, will ere long be fully attained. In many villages we see shops opened for the accommodation of the inhabitants; and butchers and bakers are establishing themselves. The consumption of meat and wheaten bread is very rapidly increasing, and the assimilation of the north of Scotland to the land of the Sassenach is almost complete. New wants are arising—the dress of the Gael has disappeared—the language is wearing away, and in half a century will be as rare as the dress is now.

Almost every part of the counties of Ross and Cromarty, capable of carrying crops, is in the highest state of cultivation. There has been, during the last thirty years, a wonderful spirit of emulation in all matters connected with agricultural improvement both among proprietors and tenants. Several able cultivators from the finest districts of the south of Scotland have settled amongst the natives, most of whom, having seen the result of the management adopted by the strangers, have, though slowly, adopted their practices. There are still some of the native cultivators who persist in following their old practices; and, wherever fences are seen in disorder, patches of waste land in the middle of fields, and the crops intermixed like Mosaic on a great scale, a stranger may be assured that the tenant is a native. While incalculable good has unquestionably arisen out of the stimulus given to improvement, much temporary mischief has also resulted from it. Many who perceived the prosperity of those who set about improving the soil with knowledge, judgment, prudence, and with that essential foundation, an adequate capital, conceived that they would become rich without them. Farms, chiefly grazings, were taken, and money obtained by negotiating accommodation bills. When the recent depression in the prices of all kinds of produce took place, the consequences were far more severe and alarming than elsewhere, and the north of Scotland will be longer of recovering from them. But it may be reasonably expected that, in this case, experience will teach wisdom, and that it is the part of a fool to spend a fortune before it is made. Unfortunately, however, habits are not easily got rid of, and more especially those engendered by ambition to imitate superiors, and to have the wives and daughters of farmers without fortune equally well dressed and accomplished as those of the landlords.

On the great majority of arable farms we now see a degree of neatness in the style of dressing the land and inclosing it, superior to most districts of England and Scotland, and inferior to none. The crops are uniformly clean, and for the most part rich, and the quality of wheat such as frequently to have topped the London markets.

Horticulture.

A spirit of improvement in horticulture has likewise arisen, and we find many excellent gardens attached to the mansions of the proprietors; and though those attached to farm houses be small, they yield abundantly both the *utile et dulce*. Some proprietors are noted for their love of horticultural pursuits, and for introducing new fruits, as well as ornamental plants heretofore unknown in the north. The climate is not very favourable for the finer departments of garden culture, and, as already observed, it has become worse since the beginning of the century. When the blossoms look full and healthy, there comes a withering frost, or rain prevents fecundation. Insects, of late years, have become numerous and defy all efforts to destroy them till nature herself finds the remedy. The cottagers are now observed everywhere to form little gardens whenever they have a patch of ground adapted for it. Formerly great quantities of onions and cabbage plants used to be sold from the gardens of the proprietors, and now scarcely any are sold, on account of their being raised by the people themselves. The robbery of gardens is not now uncommon; and of late there seems to have been a regular system established for stealing bee-hives from cottage gardens, which, in some parts of Ross-shire, are a scource of great profit to the cottagers. The people who suffer are averse to give information to the magistrates; and an instance recently occurred, in which the sheriff-substitute was the sufferer, by two sheep having been killed and flayed at his own door, when no steps were taken to trace the offenders. We have recorded these matters in order that, at some future time, the present state of the country may be compared with what it may be hereafter.

The salmon fishery is carried on to a considerable extent in the rivers and estuaries; but, owing to over fishing, and partly to the openness of the winters, it has greatly fallen off.

The herring fishery has of late been prosecuted with great success on the east coast, at Portmahomack and Cromarty; and a red-herring house has been erected on the point of Fortrose. Formerly Loch Broom, on the west coast, was esteemed one of the very best stations; and the British Fishery Society erected there the town of Ullapool, where a custom house was established. But in proportion as the fishery extended on the east coast, along the shores of Caithness and Sutherland, it fell off on the whole of the west coast, and for the last twenty years there has not been a prosperous fishing carried on. With respect to the cause of the herrings disappearing on the west coast, there have been many speculations. It may partly have been owing to over fishing, and partly to some natural cause, not to be discovered, operating to the diminution of the number of the fish. Be the cause what it may, the loss to the county has been great, and a population formerly comparatively wealthy, has now sunk into poverty, and the value of land on the coast has diminished. There is an excellent coal bank on the coast of Gairloch, which might perhaps be turned to better account than it has hitherto been.

Fisheries.

The Island of Lewis is in a state that renders it exceedingly difficult to improve it. The population is too great, and consequently very poor. The greatest proportion of the island is incapable of cultivation, and the most important improvement probably is drainage, in order to increase the quantity of herbage. The present proprietor has begun a system which, if persevered in, will probably succeed in ameliorating the condition of the island; but it will require time, and patience, and outlay. The town of Stornoway is thriving, and is the resort of much shipping. The only communication with the mainland hitherto has been by means of a sailing packet; but new measures are taking to secure the benefit of steam navigation. This will be expensive, on account of the distance from fuel; but it is presumed that it will only be resorted to during the favourable weather of summer. The sea runs tremendously high in the minch when storms blow; but now that vessels are constructed to sail as well as to go by paddles, there may be little risk to steam-boats. The valued rent of the county, including the interspersed parts of Cromarty, is £85,709, 15s. 3d. Scotch; and the real rental is supposed now to exceed £80,000, sterling. Many estates are subject to the payment of feu-duties to the crown, which formerly belonged to the earldom of Ross. The total amount is of barley 839 bolls, oats 158, oatmeal 761, which may be estimated as worth somewhat above £2000. £1790, Scotch, is likewise payable. A considerable sum is also paid to the crown for lands that formerly belonged to the bishoprick.

Valued rent.

Population.

The population of Ross and Cromarty in 1821 was 70,200, being an increase of 7300 since the former census of 1811.

ROSTOCK is a large town in the north of Germany, in the grand duchy of Mecklenburg Schwerin. It is situated about 8 miles from the mouth of the river Warnow, which flows into the Baltic at Warnemunde, where vessels that draw more than eight feet of water are obliged to unload. The town of Rostock, which is surrounded with old fortifications, and built in the old fashioned style, is divided into the old, the middle, and the new towns, and has three suburbs. It contains three churches, one university, and a grand ducal mansion. The students of the university, which was founded in 1419, amount to about 170, and the professors to 20. The other public buildings and establishments are a seminary for educating schoolmasters and clergymen, a Lutheran convent, a poors-house, a public library, a botanical garden, and a museum. The chief manufactures of the place are those of ships anchors, linen, canvass, soap, and vinegar. There are also here distilleries, breweries, and sugar refineries.

Rostock carries on a trade with England, Holland, and the Baltic seas. The value of its exports, principally gin, is from £150,000 to £200,000. The imports are coffee, tobacco, sugar, rum, and great quantities of bay salt. The number of ships which annually arrive here is about 600. Grain is exported to the amount of 130,000 quarters annually. Population about 13,000. East Long. 12° 12′, North Lat. 54° 10′.

ROTATION. See MECHANICS.

ROTATION OF CROPS. See AGRICULTURE, Vol I.

ROTHBURY, a small parish and market-town of England in Northumberland. It is situated in a romantic glen on the river Coequet, and consists principally of one street of ancient, if not well built houses, erected on the road from Alnwick to Wooler. The church is an ancient structure, in the form of a cross, and contains a font of curious workmanship, and several respectable monuments. There is here a bridge of three arches over the Coquet. The rector's mansion was formerly Whitton house, which was one of a line of houses extending from Hepple to Warkworth. Rothbury forest, which now contains very little wood, is about seven miles long, and five broad. There is here a charity school for 120 children. Population of the town in 1821, 891 inhabitants, and 146 houses. See the *Beauties of England*, vol. vii. p. 208.

ROTHERHAM, the name of a market-town and parish of England, in the West Riding of Yorkshire. It is situated in a valley on the river Don, at its junction with the Rother, the former being crossed by an elegant stone bridge. The streets of the town are on the roads to Barnsley, Doncaster, Bawtry, Mansfield, and Sheffield, and are rather irregular and uneven. The houses, though well built of stone, have a dull and dingy aspect. The public buildings, are the town hall, the parish church, which is a handsome and spacious edifice, a meeting-house for Independents, and another for Methodists. To the parish church is attached a school for 30 children. There is here an academical institution for dissenting clergymen, called "The Rotherham Independent Academy." It was opened in 1795. The building for it, erected by the late Samuel Walker, Esq., accommodates 16 students. The library contains 1200 volumes. On the other side of the bridge is the village of Mossborough, containing the extensive iron-works of Messrs. Walker, which were commenced in 1746. The cast iron bridges of Sunderland, Yarm, and Staines were founded here Cannons and cast iron goods of all kinds, along, with articles in wrought iron, tin plate, and steel goods are also made here in great quantities. A very large porter and ale brewery has lately been established in the town.

This town possesses great facilities in water carriage by the Don, which is navigable to Sheffield, by the Stainforth and Keadley canal, and by the Dearn, Dove, and Barnsley canals. Coal and iron are obtained from mines in the neighbourhood. At the village of Wickersly, in the neighbourhood, grindstones are manufactured, of which about 5000 are said to be sent annually to Sheffield. Population of the town in 1821, 3548; number of houses 417. West Long. 1° 22′, North Lat. 53° 25′. Wentworth House, the princely residence of the Earl of Fitzwilliam, is in the neighbourhood of Rotherham. See the *Beauties of England and Wales*, vol. xvi. p. 828.

ROTHERHITHE, a village of England, in the county of Surrey, and now connected by buildings with the burgh of Southwark along with which it has been considered as part of London. See LONDON, Vol. XIII.

ROTHESAY, a royal burgh of Scotland, is situated on a bay of the same name, on the north-east side of the Island of Bute, and is the chief town of the county of Bute. It is governed by a provost, two bailies, a dean of guild, a treasurer, and twelve ordinary councillors, and unites with Ayr, Irvine, Inverary and Campbelltown, in sending a member to the British parliament. Besides the burgh courts, the sheriff and justice-of-peace courts, and county meetings are held here.

Rothesay castle, now a noble ruin, was probably one of those erected by Magnus Barefoot, king of Norway, in 1098, to secure his conquest of the western islands of Scotland. A village gradually arose around the walls, and under the protection of the castle. Bute being one of the ancient possessions of the House of Stuart, the castle of Rothesay continued to be an occasional place of their residence after they came to the throne, and on the 12th January 1401, King Robert III. erected the village into a royal burgh, and endowed it with a considerable landed territory. Its privileges were confirmed and extended by King James VI. by charter dated 19th February 1585.

Rothesay was one of the principal seats of the Catholic bishops of the Isles, and after the Reformation it became the chief seat of the Protestant bishops of that diocese.

The town of Rothesay necessarily shared the fate of its castle, in the various wars in which Scotland was engaged, and has been repeatedly taken and plundered by the Norwegians, by the lords of the Isles, by the English, and by the different parties during the civil wars. Notwithstanding of which, the town seems to have attained some degree of prosperity, as it enjoyed the advantage of being a mart, at which the Highlanders and western islanders met with the Lowlanders to exchange their various commodities; and hence arose the opinion, still prevalent, that Bute is a kind of neutral ground, neither belonging properly to the Highlands nor Lowlands. About the time that Campbelltown was erected into a royal burgh (1700,) the family of Argyle offered great inducements for people to settle at that place, and many of the traders of Rothesay availed themselves of those tempting offers. Having thus lost not only a great part of her traders, but her trade also, the town fell greatly into decay, insomuch, that by the year 1760, nearly one half of the houses had been allowed to fall into ruin, and the population was greatly reduced. It continued in this languishing state till 1765, when a custom-house was established here, for the accommodation of the Irish colonial trade, (all colonial produce requiring at that time to be landed in Britain before it could be imported into Ireland.) The inhabitants of Rothesay then engaged in the herring fishery, in which they were very successful; the town arose from its ruins, and the harbour was enlarged. An English company having, about the year 1778, established a cotton manufactory here, the first in Scotland, (which was soon afterwards transferred into Scotch hands,) contributed much to the prosperity of the place, by affording employment for the poor, and bringing many people to settle in the town. These mills have been recently enlarged, and greatly improved by Mr. Thom, particularly by his various inventions, whereby he has superseded the steam-engines formerly employed there, by water-power; and that by means at once so simple, economical, and effectual, as to bid fair to render their application universal.* Besides those branches of industry, and the trades necessarily connected with them, there are two tan-works and a distillery; and a steam loom factory has been lately established. The harbours being found insufficient for the accommodation of the increased number and size of the vessels belonging to the place, they were lately rebuilt and improved at an expence of above L.5000 sterling.

For many years past, Rothesay has been resorted to by such sea-bathers as were fond of retirement; but the general adoption of steam navigation, in 1814 and 1815, having rendered the access to this place so easy, it soon became a fashionable watering place; the demand for houses has increased so much, that new streets have been laid off on each side of the bay, and additional houses are continually erecting.

According to the statistical account, by the minister, the population of the town was, in 1766, 1158; in 1771, 1411; in 1781, 1701; and in 1790, 2607. When the government census was taken in 1801, the population of the town was 4000; but in 1811, it had, from various causes, declined to 3544; in 1821, it was 4107, and it has since considerably increased, and is now estimated at above 5000. †

Rotterdam.

ROTTERDAM, a city and sea-port town of Holland, situated on the north bank of the Maese, about 20 miles from its mouth. The town is traversed in a north-west direction by the Rotter, a small river which here falls into the Maese. Rotterdam is built in the shape of a triangle, the longest side of which stretches for about a mile and a half along the banks of the Maese, which has here the appearance of an arm of the sea. The city is encircled with a moat, and has six gates, two of which enter from the water. The streets are long, and generally narrow, and the foot pavement consists of a line of bricks. The principal streets are the Boomtjies, which contains the finest buildings in the city; and the Haringvliet. The houses, which are more convenient than elegant, are four, five, and six stories high, and in some places the upper stories project over the lower ones. The windows are unusually large, and the ground floor is generally occupied only by an arched gateway to the back warehouses.

The principal public buildings are the town house, the exchange, completed in 1736, the East and West India houses, the arsenal, the church of St. Lawrence, and other churches, including an Episcopalian chapel, and a Scotch Presbyterian church. The top of the church of St. Lawrence commands a view of the Hague, Leyden, and Dort. There is also here an academy, a theatre, and the college of the Lords of the Admiralty. Among the monuments in Rotterdam are the tombs of Admirals Dewit and Von Braakel, and a bronze statue of Erasmus, who was born in that city. Among the literary collections and institutions are a cabinet of natural history and of antiquities, a public library, and an academy of sciences, instituted in 1771.

Rotterdam has long been celebrated as a commercial

[*] Several of the ingenious inventions by which Mr. Thom has effected this change, will be found described in Dr. Brewster's *Edinburgh Journal of Science*, vol. i. ii. iii. and iv.

[†] The Editor has been indebted for this article to John M'Kinlay, Esq.

Rotterdam
||
Rouen.

city, and it possesses great advantages in that capacity. Vessels of great burden are able, by means of broad and deep canals which intersect the city, to unload their cargo at the very door of the merchant's warehouse, entering two great inlets from the Maese, the one stretching to the east, and the other to the west, till they meet. The Maese being free from ice, and a single tide being sufficient to carry vessels from the harbour to the German Ocean, this port has been more frequented by British traders than that of Amsterdam, the passage to which is more tedious and difficult.

Rotterdam flourished most in the 17th and 18th centuries; but after the invasion of the French and the war with England, its commerce was nearly destroyed.

The following table will show its progressive state:

Years.	Vessels that entered the port.	Years.	Vessels that entered the port.
1802	1786	1809	almost none.
1803	850	1810	
1804	693	1811	
1805	679	1812	
1806	381	1813	
1807	294	1814	1284
1808	65	1815	1683
		1817	1781

The 1731 vessels that arrived here in 1817 came from the following ports:

Riga	272	Dantzic	31
Leyden	253	Hull	28
Harwich	110	Kiel	22
Petersburg	90	Archangel	20
Libau	73	Lisbon	16
Newcastle	62	Bourdeaux	15
Bergen	45	Hamburg	10

The number of vessels that sailed in 1817 was 1771.

The imports from England are hardware, cotton, woollen goods, &c. and are greater than those from any other country. Population about 56,000. East long. 4° 29′ 11″ North Lat. 51° 55′ 22″. See Rordanz's *European Commerce*, p. 417—422.

ROTULA, Astronomical, the name of a machine invented by James Ferguson for calculating eclipses, and various other astronomical phenomena. It consists of a great number of moveable circles of different sizes, having their divisions engraven on paper. See the life of Ferguson.

ROUEN, a city of France, and the capital of the department of the Lower Seine, formerly of Normandy, is pleasantly situated in a fertile and agreeable country on the right bank of the Seine. The town, which is of an irregular oval form, is two miles long and one broad. The streets, though straight, are narrow; and from the height of the houses, and the projection of the upper stories of many of them, which are built of wood in the ancient style, the rays of the sun scarcely reaches the street. The quays on the Seine are extensive, and contain many good houses. The squares of the town are small and poor. In the space called the *Marche aux Veaux*, is the statue of the celebrated Maid of Orleans, whom the English burnt as a witch in 1430. One of the principal public buildings is the cathedral, which was founded by William the Conqueror, and is considered one of the finest specimens of Gothic in France. It has a very handsome front, with two lofty steeples, and it had a bell thirteen feet high, and eleven feet in diameter, which probably still exists. The church of St. Maclou is much admired, and also that of St. Ouen, which is a fine Gothic structure near the centre of the city. The town-house is handsome, and the barracks are capable of holding a number of troops; and the great hospital is a fine building. The other public buildings are the parliament house, the old castle, the prison, the exchange, and several churches and convents, now used for secular purposes.

The bridge of boats over the Seine, which rests on nineteen large barges, rising and falling with the tide, was to be replaced by a handsome bridge of stone, which must now be nearly finished. Rouen has long been one of the principal manufacturing cities in France. Coarse cottons are made here to a great extent, and finer ones have been making great progress. Woollen and linen goods are also manufactured, together with wax cloth, paper, hats, pottery, iron goods. The dyeing of woollen and cotton has been long carried on here to a great extent; and there are several sugar refineries. It has been estimated that 50,000 of its population are employed in manufactures; and that the annual value of its industry is about £2,000,000 sterling.

The commerce of Rouen is not great. By the river, which is here from 500 to 800 feet wide, it is seventy miles from the sea. Ships of 150 to 200 tons burden can go up to the town by the aid of the tide, larger ones being lightened farther down the river. The intercourse between Rouen and Paris is likely to be much increased by the use of steam-boats.

Among the literary institutions of Rouen are the Academy of Belles Lettres, instituted in 1744; a society of agriculture and the arts, founded in 1791; classes for medicine and surgery; a central school; a school of navigation and drawing; a botanical garden; a museum of natural history; and a collection of paintings.

The environs of the town are very agreeable. The beautiful promenade of the Cours on the banks of the river, the esplanade, and the hill of St. Catherines, present to the eye of the stranger many agreeable objects. Population 87,000. East Long. 1° 5′ 59″, North Lat. 49° 20′ 27″.

ROVEREDO, or Rovereith, a town in the Tyrol, situated on the left bank of the Adige, on the road from Trent to Verona. The town is neat and well built, though not remarkable for any public edifices or large mansions. Many of the houses are built of marble, which is found in the vicinity. The silk manufacture was carried on here to a great extent about the middle of the eighteenth century; but it has now greatly decreased. East Long. 11° 0′ 35″, North Lat. 45° 55′ 36″.

ROVIGNO, a town of Austria, on the coast of Istria, situated on a rock jutting into the sea, and forming two good harbours. The town is a mile in circumference. The inhabitants are principally employed in ship-building, in the pilchard fishing, and in the sale of wood. The productions of the vicinity are wine, olive oil, and fine marble. Population 10,000.

ROVIGO, the name of a town of Austrian Italy, and capital of a district of the same name. It stands on the Adigetto, and is defended by a wall, a moat, and a fortified castle. The chief edifices are the churches, and the palace of the chief magistrate, built in a large square. Maize, flax, hemp, and silk, are raised in the neighbourhood, which is intersected by canals and rivers. Population 9000. S.S.W. of Venice 35 miles. East Long. 11° 48′, North Lat. 45° 4′.

ROUSAY. See Orkney Islands, Vol. XVI. p. 7.

Rousseau, Jean Jacques.

ROUSSEAU, Jean Jacques, a celebrated writer, was born at Geneva on the 28th of June, 1712. His father, a watchmaker by profession, was a citizen of Geneva, and had such a taste for literature, that he constantly kept in his shop copies of Plutarch's Lives and Tacitus; and it is probable that a love of learning was imbibed by Rousseau from the conversation and pursuits of his father. Its growth, however, was impeded by early habits of idleness and vice, which prevented him from availing himself of those means of instruction which accident had thus put in his power. He was first apprenticed to an attorney, who discharged him for his negligence; and having been next sent to learn engraving, his master is said to have disgusted him by his harshness; a term which was probably much misapplied. The dread of punishment for his vices drove him from his father's house; he introduced himself to Borney, bishop of Annecy, and no doubt gained a hospitable reception, under the pretence of becoming a convert to the Catholic faith. The bishop committed the young proselyte to the charge of a Madame de Warrens, a well-informed, though unprincipled woman, who had, in 1726, sacrificed part of her fortune by becoming a Roman Catholic. This lady placed her pupil in a Catholic seminary at Turin, where, after having his conversion confirmed, he was sent into the world with twenty florins in his pocket. As soon as he had exhausted this little fund, he went into the service of a countess, where he stole a ribbon, and laid the blame upon an amiable young woman who lived in the house. On the death of the countess he became a servant in the family of a nobleman, whose son instructed him in literature, and treated him as a companion. By his misconduct, however, in this situation, he was dismissed from his place, and took refuge under the roof of Madame de Warrens, who, having formerly acted towards him the part of a mother, now discharged the duties of a lover. Desirous, however, of seeing him settled in life, she got him appointed secretary to a commission, organised by the king of Sardinia for surveying lands; and, in this situation, which he held for two years, he devoted himself to the study of geometry and music. The seductions, however, of the last of these studies, soon made him renounce its graver companion, and he resolved to follow music as a profession. The Abbé Blanchard having failed in procuring for him a place in the chapel royal, Rousseau was reduced to the necessity of teaching music at Chamberry. Here he spent eight years intimately connected with Madame de Warrens; but a coolness having arisen between the lovers, probably from his infidelities, the lady procured for him the situation of tutor to the children of M. Mably, at Lyons, a situation which he had not steadiness enough long to maintain. He accordingly went to Paris in 1741, where he spent two years in obscure and penurious circumstances, till, in 1743, his friends obtained for him the appointment of secretary to M. de Montaigne, ambassador from the court of France to Vienna. He soon, however, found an opportunity of quarrelling with the ambassador; and returning to Paris, he supported himself by his musical talents, and devoted much of his time to the study of natural philosophy and botany, in the last of which science he made great proficiency. He was soon after appointed deputy to M. Dupin, one of the farmers-general, and, from the profits of this situation, he was enabled to extend some pecuniary aid to Madame de Warrens, who was now in necessitous circumstances.

In the year 1748, when he was only 36 years old, Rousseau began to experience the attacks of a painful disease, which afflicted him during the rest of his life, and which induced him to confine himself more than he had hitherto done to sedentary and literary occupations.

Under these circumstances, he conceived the design of writing for the prize which the academy of Dijon had offered in 1750, for the best essay on the following question, *Whether the revival of the Arts and Sciences has contributed to the refinement of Manners?* Rousseau was at first disposed to support the pretensions of the sciences, but his friend Diderot urged him to adopt the opposite line of argument, and promised him the success which generally accompanies bold and extravagant opinions. Rousseau accordingly wrote an elaborate and ingenious attack upon the arts and sciences; and such was the eloquence which it displayed, and the ingenuity of its reasonings, that it was crowned by the Academy, and excited great interest in the literary world. It was attacked, as might have been expected, by various authors, among whom was Stanislaus, king of Poland; and Rousseau was ridiculed on the stage of Nancy in the *Comedie des Philosophes*, the production of Palissot, one of the members of the Academy. The king of Poland, as Duke of Lorraine, desired Palissot to write a letter of apology to Rousseau, and deprived him of his place in the Academy; but Rousseau had the good feeling to solicit, and the influence to obtain his restoration.

In the year 1752, Rousseau began to write for the stage. He composed his *Narcisse ou l'Amant de lui-meme*, and the musical piece of *Le Devin du Village*, or the Village Conjuror, the last of which had a successful run at Paris, and has been much admired for the simplicity and gaiety of its sentiment, the elegance of its diction, and the suitableness of the words to the music. His *Lettre sur la Musique Française*, in which he attempted to show that the French never had, and never could have, any thing like vocal music, in consequence of the defects of their language, followed the above piece, and involved him in attacks and lampoons of every kind.

Having thus acquired great celebrity, he returned to his native city to claim the admiration of his fellow citizens. For this purpose he abjured the Catholic faith, and was restored to the rights of a citizen of the republic. Here he composed his *Discours sur les Causes de l'Inegalité parmi les Hommes, et sur l'Origine des Societés*, which he dedicated to the republic of Geneva. As he had already derived so much fame from the support of an ingenious paradox, he seems to have confided too much in the good nature of the public, by continuing to do violence to the feelings of mankind, by opposing their common and best founded opinions. In the discourse now mentioned, he endeavours to show that mankind are equal, that they are born to live in a savage state, and that every social compact is a deviation from the arrangements of nature. Sentiments like these, and rhapsodies however elegant, on the superiority of savage life, were not even fitted for the meridian of a republic, and could not fail to disgust the sober citizens of Geneva. Our author accordingly did not reside long in that city. From Paris, in which he remained some time, he retired to Montmorency, where he composed, in 1758, his Letter to M. d'Alembert, respecting the design then agitated of establishing a theatre at Geneva. This letter exhibits great knowledge of life and character; and though d'Alembert and Marmontel replied to it, he succeeded in proving that a theatre was not necessary under the circumstances in which Geneva was then placed.* Voltaire is said to have been so enraged with the letter of Rousseau, that it laid the foundation of that mutual dislike which ever afterwards subsisted between them.

In the year 1760, Rousseau completed his *Lettres de deux Amants*, or his *Julie, ou la Nouvelle Heloise*, and published them in six parts. This work may be characterized as a novel, of which the plot is ill-contrived and unskilfully brought out, and in which the characters are ill drawn and ill kept up. It possesses no dramatic beauties, but owes its reputation to the force and vigour of its diction, to exaggerated but beautiful representations of impassioned feeling, and to seductive but elegant sentiments. Amid many lessons of virtue and of prudence are scattered baneful and dangerous maxims; and it is scarcely possible for a youthful mind of ordinary equilibrium, to rise from the perusal of it without having its judgment unsettled, its principles reversed, and its hopes blighted. All the sacred and august opinions which the sagacity of ages has sanctioned, and rendered venerable, are here brought under the scourge of disputation; and the existence of God himself is arraigned at the bar of human wisdom.

Encouraged by the success of this work, Rousseau embarked in one of a more profound, though not less dangerous character. It was entitled, *Du Contrat Social, ou Principes du Droit Politique*, and from its ardent vindication of republican doctrines, is supposed, not without reason, to have led to the French revolution. Voltaire ridiculed it, by calling it the *Universal Compact*. Some have praised it as the greatest effort of his genius, while others consider it as full of absurdities, contradictions, and errors, and as unworthy of the talents of its author. This work was prohibited in France and Switzerland, and laid the foundation of those quarrels, dissensions, and persecutions, which embittered the remainder of his life.

The next, and what may be regarded as the principal work of Rousseau, was his *Emile, ou de l'Education*. This moral romance, which appeared in 1762, treats chiefly of education. The plan of instruction which is here inculcated, is to allow the youthful mind to unfold itself without restraint, and rather to protect it against bad impressions, than to attempt to load it with positive instruction. The objects of nature are to be gradually presented to it. Necessity alone *is* to regulate and restrain it, till reason, unfettered by prejudice and previous habits, is able to weave the drapery in which it is afterwards to be swathed. This child of reason, thus thrown into a mass of human beings, actuated by different motives, guided by different principles, and pursuing different objects from itself, like a skilfully constructed bark without its rudder, and stripped of its canvass and cordage, can have no other fate than that of being dashed against the cliffs, or sunk beneath the waves. In discussing the subject of religious education, he exhibited the same inconsistency and absurd views. The French savants were displeased with his glowing sentiments of piety, with his impassioned admiration of the morality of the gospel, and of the character of its founder; while the friends of religion and social order were shocked with his attacks upon miracles and prophecy, with his insidious and open objections to Christianity, and with the application of human reason to subjects beyond its sphere, and above its power. The French parliament not only condemned the *Emile*, but compelled Rousseau to retire precipitately from France, by commencing a criminal prosecution against him. From Paris he fled to Geneva; but his native city refused him admission; and his book was burned by the hands of the common hangman at Geneva as well as in Paris. In Switzerland, where he had taken shelter, he was kindly treated by Marshall Keith; and he established himself at Moutiers Travers, in the Val Travers, near Neuchatel, where his house is still shown, and the desk against the wall at which he wrote standing. In this retreat he composed his letter to the Archbishop of Paris, in reply to his *Mandement* for the burning of Emile, and also his *Lettres de la Montagne*, in which he attacked the republic of Geneva, and the clergy; and finally renounced the privilege of citizenship which had been restored to him.† This attack upon the clergy excited a general hostility against the philosopher. The minister of the parish is said to have preached against him, and to have excited such an uproar among the people, that on the night of the 6th September, 1765, they broke his windows with stones,‡ and forced him to take up his abode in an island in the lake of Bienne. A recent traveller, M. Simonde, remarks, that the rabbit island of which Rousseau speaks, has not a tree, a bush, or a blade of grass; and that Rousseau's residence, which is the only house on the island, is a substantial, neat, and orderly farm-house, built round a court shaded by a huge walnut tree.

Rousseau now sought for protection from the Bernese government; but, in consequence of the connexion which subsisted between it and the republic of Geneva, they refused to grant it, and insisted upon his quitting the city. He entreated them to shut him up in the common prison; and as this was of course refused, he set off from Berne in an inclement season, and arrived at Strasburg in a very destitute state. Here he was kindly received by the Marshal de Contade, governor of the city, who treated him with the greatest kindness and generosity. From Strasburg he went to Paris, where he exhibited himself in the dress of an Armenian, and had the good fortune to become acquainted with our celebrated countryman David Hume, who was then resident in the capital as chargé d'affaires from the English court. Commiserating his destitute condition, Mr. Hume took him along with him to England in the beginning of 1766, and obtained for him an agreeable settlement in the family which he had himself chosen as the best asylum from his enemies. A character so compound, so capricious, so insincere as that of Rousseau, was incapable of making a favourable impression upon an English mind. His licence of speech, which made him an object of wonder abroad, excited no notice in a country where every man can say what he pleases; his melancholy and troubled temperament had not even the charm of peculiarity in our land of clouds and fogs; and his overweening vanity did not find among our grave countrymen any food for its insatiable appetite. Rousseau was therefore soon disgusted with England. Although he himself chose to speak openly of all things, and of all men, yet his love of liberty could not brooke that he himself should be the subject of free discussion. The English newspapers sneered at his peculiarities: they published a forged letter from the king of Prussia, ridiculing the principles and conduct of Rousseau, as adapted to a modern Diogenes. Such treatment was not congenial to a distempered mind like Rousseau's, and it annoyed him the more as it was the act of a liberal and free people. Here he had no corrupted priesthood to rail at, no fanatical ministers to ridicule, no despot to satirize. He therefore conceived that there was a general confederacy organized against him of all sects and parties. He imagined that his friend and benefactor, Mr. Hume, had leagued himself with the French philosophers against his peace and glory, and that he had brought him to England to expose him to the ridicule of his countrymen. Full of these opinions, and equally full of his own importance, he addressed an abusive letter to Mr. Hume, and renounced a pension which that amiable man had succeeded in obtaining for him from the English government.*

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* An account of this controversy will be found in our Life of d'ALEMBERT, Vol. I. p. 250.

† The following is a specimen of his mode of attacking the clergy, which is neither marked by candour nor intelligence. "On demande," says he, "ceux ministres de l'Eglise de Geneve, si Jesus Christ est Dieu, ils n'osent repondre. Un philosophe jette sur eux un coup-d'œil rapide. Il les penetre, il les voit Ariens, Sociniens, Deistes: il le dit, et pense leur faire honneur! Aussitot alarmés, effrayés, ils s'assemblent, ils discutent, ils s'agitent, ils ne savent à quel sainte se vouer, et après force consultations, délibérations, conférences, le tout aboutit à un amphigouri! Où l'on ne dit ni oui ni non. Oh! Genevois! ce sont en verité singulieres gens que Messieurs vos Ministres! on ne sait ni ce qu'ils croyent, ni ce qu'ils ne croyent pas. On ne sait pas même qu'ils font semblant de croire, leur seule maniere d'établir leur *foi*, est d'attaquer celles des autres."

‡ M. Simond remarks, that some of the older inhabitants who remember Rousseau, "admit that there were a few stones thrown at him in the house by boys in the village; but question whether it was on account of his writings, and rather suppose they were instigated by his *gouvernante*, who was tired of the place, and wished to disgust him with it."—Simond's *Switzerland*, vol. i. p. 27.

From England he went to Paris in 1767, and in 1768 he published his *Dictionnaire de Musique*, composed principally of the musical articles which he had contributed to the Encyclopedie. This work, though it contains many good articles, many excellent observations, and many just criticisms, is yet full of inaccuracies, and has a tendency to mislead the student.

In the year 1769, when he was in the neighbourhood of Lyons, Rousseau married his governess Mademoiselle le Vasseur, a woman devoid both of beauty and talents, but who, from a devoted attention to him in health and in sickness, had gained over him an ascendancy which was unfortunately used rather to exaggerate than to subdue his peculiarities. By this lady he had already five children, all of whom he had basely sent to the orphan hospital; a step which he never scrupled to avow and to defend. Although the married state did not introduce Rousseau to the "matchless joys of virtuous love,"

> An elegant sufficiency, content,
> Retirement, rural quiet, friendship, books,
> Ease and alternate labour, useful life,
> Progressive virtue, and approving heaven;—THOMSON,

yet his entrance into that state was a sort of homage paid to those social principles which it had been the business of his life to deride; and when he agreed to shackle his licentious love by "the coarser tie of human laws," he may be considered as having expressed some regret for his crime, in the fulness of his age, and the maturity of his intellect. Yet this was perhaps only another caprice of his unsettled temper, and we should have regarded it as such, had it not been certain that this was the most rational period of his life, and that he now sought for tranquillity of mind in the peaceful study of the productions of nature. At Bourgoin, in Dauphiny, where he resided, he embarked eagerly in botanical study, and employed himself diligently in collecting and examining the plants which abound in the mountainous districts of that province. This study was by no means a temporary pursuit, taken up for the moment. It occupied his best talents, and, such was his ardour, that he corresponded on botanical subjects with the late M. Gouan, professor of botany at Montpellier.† The correspondence of this botanist has fortunately fallen into the hands of our eminent countryman Dr. Hooker; and through his kindness we have now before us two of Rousseau's letters to M. Gouan,‡ exhibiting along with the utmost amiableness of character, a thorough knowledge of the subject on which he writes, and, as Dr. Hooker remarks in a note prefixed to these letters, "and has shown himself thoroughly acquainted with the principles of the science, and exhibited a degree of modesty and diffidence in his own knowledge which is seldom found in persons of much inferior acquirements. They are dated," continues Dr. Hooker, "from Dauphiny in Savoy,‖ in the year 1769, eight years before his death, during that period when he concealed his real name under that of Renon, when returning from England disgusted with the world, he sought for amusement and health in investigating and studying the vegetable creation in the beautiful alpine district just alluded to; and we trust that they will be found to strengthen the remark made by Sir J. E. Smith, under his article ROUSSEA§ in Rees' *Cyclopædia*, that 'botany had spread a charm over the latter years of this distinguished man, and soothed their real and imaginary evils;' and that whenever he touches on this favourite subject in his writings, he communicates the same charm to his readers." The effect which was produced by the Letters on Botany of J. J. Rousseau, in giving popularity to the Linnæan system in France is well known; and even in this country we could scarcely mention any truly elementary work which has been more generally read and admired, or which appears more calculated to encourage a taste for the science especially among young students.

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* See our Life of HUME, Vol. XI. p. 348, for a full account of these transactions.

† Rousseau corresponded with Linnæus, who had dedicated a genus to his name; but Linnæus the younger, inadvertently published it as *Russellia*.

‡ These letters are published in Dr. Brewster's *Journal of Science*, Vol. IV. p. 246. No. VI. for July—October, 1825.

‖ The first is dated from Bourgoin in Dauphiné, 28th May, 1769; and the second from Montquin, 6th October, 1769.

§ A genus named by Sir James after Rousseau.

The pleasures of solitude, and the pursuits of botany, seem to have soon lost their influence over Rousseau's mind, and we find him again in Paris in the year 1770. There he appeared on the 1st of July, at the Regency coffee-house, dressed in his usual simple garb, and enjoying the acclamations and praises of a Parisian mob. The sentence of imprisonment, passed on account of his Emile, was still in force; but his friends procured for him the permission of residence, on condition that he should neither write on religion nor politics. This injunction he rigorously obeyed. His life run on with serene tranquillity; and when the clouds of religious and political controversy had passed from his horizon, a burst of sunshine followed, which continued with more or less brightness to gild the remainder of his days. In May 1778, Rousseau and his wife accepted of an invitation from the Marquis de Girardin, to take up his residence in a small house near his beautiful seat of Ermenonville, about ten leagues from Paris. This elegant retirement he was not destined to enjoy. On the 2d of July, 1778, he was carried off by a stroke of apoplexy in the 66th year of his age. The Marquis erected a monument to his memory in the Isle of Poplars, in his pleasure grounds, with the following inscription:

ICI REPOSE
L'HOMME DE LA NATURE
ET DE LA VERITÉ!
VITAM IMPENDERE VERO*
HIC JACENT OSSA J. J. ROUSSEAU.

The relics of Rousseau were afterwards carried to Paris; and in 1814, we saw the tomb with the above inscription in the Pantheon of the French metropolis.

After the death of Rousseau, there was found among his manuscripts a work entitled his "Confessions," which contains a particular account of all his vices and virtues, of all indeed which befel him till the 30th year of his age. This work was left to his friend Mr. M.— with instructions to publish it "after his death;" instructions which were unfortunately complied with. It is impossible to suppose that this work was the production of a repentant spirit. Vanity alone must have inspired it; and it is mortifying to think, that our species contained one individual who, in the hour of health, could record such incidents; and, in the hour of death, bequeath to the public a record to disgrace his name, and operate as a moral poison among his fellow creatures.

The following interesting account of Rousseau's Confessions, and of his MSS. has been recently given by M. Simonde, in the work already quoted.

"Mr. M.—— son of the friend of Rousseau, to whom he left his MSS. and especially his Confessions, to be published after his death, had the goodness to show them to me. I observed a fair copy, written by himself in a small hand like print, very neat and correct, not a blot, even an erasure, to be seen. The most curious of these papers were several sketch-books, or memoranda, half filled, where the same hand is no longer discernible; but the same genius, and the same wayward temper and perverse intellect, in every fugitive thought recorded. Rousseau's composition, like Montesquieu's, was laborious and slow; his ideas flowed rapidly, but were not readily brought into proper order; they do not appear to have come in consequence of a previous plan, but the plan itself formed afterwards came in aid of the ideas, and served as a sort of frame for them, instead of being a system to which they were subservient. Very possibly some of the fundamental opinions he defended so earnestly, and for which his disciples would willingly have suffered martyrdom, were originally adopted because a bright thought, caught as it flew, was entered in his commonplace book. Those loose notes of Rousseau's afford a curious insight into his mode of composition. You find him perpetually retrenching epithets—reducing his thoughts to their complete expression, giving words a peculiar energy by the new application of their original meaning—going back to the *naiveté* of old language, and, in the artificial process of simplicity, carefully effacing the trace of each laborious footstep as he advanced; each idea, each image, coming out at last as if cast entirely at a single throw, original, energetic, and clear. Although Mr. M.—— had promised that he would publish Rousseau's Confessions as they were, yet he took upon himself to suppress a passage explaining certain circumstances of his abjurations of Anneci, affording a curious but frightfully disgusting picture of monkish manners at that time. It is a pity that Mr. M.—— did not break his word, in regard to some few more passages of this most admirable, most vile, of all the productions of genius.

"A copy of the first edition of *Emile*, with original notes by Voltaire, is preserved in the library of Mr. De C.—— at St. Jean; his family had much intercourse with Voltaire, being near neighbours, and were on an intimate footing with him. I shall only mention one of the notes, by which the tone of the rest may be estimated. *Le miserable* (Voltaire speaking of Rousseau,) *n'a de l'esprit que lorsqu'il parle contre la religion!*

"A few Genevans remember having seen Rousseau when he came, in 1754, to change back again from the Catholic to the Protestant communion. I was taken to a confectioner's shop, the fourth house on the right going up the *Rue de Coutance*, where Rousseau frequently dined at that time tête-a-tête with his friend the confectioner, (a predecessor of the present occupier) in the small back room serving as a kitchen. His nurse, then an old woman, carried on some petty dealings of her own in one of those booths in use at Geneva, outside of the foot pavement in the lower streets. Rousseau used to go before dinner and sit by her on a low stool, while the people collected round to look at him, proud to think he was one of them. Madame C.——, then twelve years old, remembers being raised on a chair, that she might see the philosopher over people's heads, and his figure and general appearance are still present to her memory. A bob wig with a hat, pepper and salt coat, waistcoat and breeches; his right hand on the knee of the old nurse; a round face, with piercing black eyes and pleasant smile. Notwithstanding his long absence from Geneva, and his *eloquence*, he spoke broad St. Gervais, and was not less dear to the people on that account. Forty years after this, in the fervour of the revolution, the street in which it was supposed Rousseau was born received his name, and preserves it still; but though his father had at a later period lived there, it appears that at the time of his birth the family resided in what is called *La Grande Rue*, opposite the hotel of the *French resident*, who became an ardent but Platonic admirer of Rousseau's mother; a very handsome, very sensible, and very virtuous woman. The birth of Rousseau cost her her life." Simond's *Switzerland*, p. 498.

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* This was Rousseau's motto.

Among the works of Rousseau which have not been noticed, and which are contained in a new edition of his works published after his death, are the following: 1. The Reveries of a Solitary Wander, being a Journal of the latter part of his Life. 2. Considerations upon the Government of Poland. 3. The Adventures of Lord Edward, a novel. 4. Various Memoirs and fugitive Pieces, with a great number of Letters. 5. Emilia and Sophia. 6. An Opera and a Comedy. 7. Translations of the First Book of Tacitus's History.

The best edition of his works published collectively, is that which appeared in twenty-seven vols. 4to.

It would, we think, be a hopeless task to attempt, with any degree of success, to delineate the character of Rousseau. There perhaps never was a gifted being so mysteriously compound, and whose moral nature so utterly defied all the powers of analysis. In its irregular outline, and amid its ever-changing manifestations, it is in vain to seek for any individuality by which it can be characterized: Now we find it clouded with dark suspicions; now exasperated by disappointment; now wound up in its own selfishness; now elevated by noble feeling; now panting for laurels that were not won; and now sinking under exhausted passion into a state of serenity, if not of virtue. The vices and eccentricities of Rousseau have been ascribed to the imbecility of his bodily frame, and to the peculiar sensitiveness of his mind; but we cannot find, either in his life or writings, any justification of this opinion. Rousseau was not driven into vice by the resistless tide of passion; he did did not sink into poverty through idleness or imprudence; nor did he suffer persecution because he cherished opinions adverse to religion and morality. It was his pride to be vicious, to be poor, and to be persecuted. He published his own vices in their worst form, in order to attract notice and excite criticism. He affected poverty, to gain sympathy and move pity. He invoked persecution before he had conjured up its spirit; and it seems to have been his most ardent wish to live the life of a martyr, though he tried in vain to obtain its consummation. If the leading object of Rousseau's life was to make himself an object of notice in the world; if he entered upon a new course of folly and of vice, when he had exhausted the novelties of the last, it becomes no difficult matter to form a tolerably correct estimate of his intellectual attainments. That Rousseau enjoyed a high degree of contemporary fame cannot be denied by those who are acquainted with the recent history of the literature and politics of Europe; but his reputation is that of notoriety more than of talent, and must gradually sink to the level at which his genius is capable of sustaining it. That Rousseau was a man of powerful talent, that he was an elegant writer, and an acute reasoner, cannot be denied; but we look in vain through his pages for traces of that original and inventive faculty which constitutes genius and secures immortality. In his works of fiction we find no beings of creative fancy, no force of wit, and no power of sustaining character. Eloquent descriptions, scenes of tenderness and pathos, and the ebullitions of highly excited passion, supply their place, and indicate the peculiar character of his talents. Even his grave works were wrought up by a slow process of elaboration and correction; and eloquence, ingenuity, and refined taste are their most prominent characteristics.

The reputation of Rousseau, therefore, cannot be supported by the permanent influence of his writings. His contemporary fame, already much reduced, is sinking fast to its level; and that very reputation, to which his talents give him a claim, is likely to be blighted by the vice and immorality which poison the works on which it must depend. How different is the progress to immortality of the fame of true genius. Founded on the judgment, and not on the passions of men, it is seldom blessed even with the expression of contemporary praise. Death first gives it form, and, disencumbered of its mortal coil, it gathers strength and magnitude, and floats the laurels of its possessor, in full tide, to the most distant ages.

ROWE, Nicholas, an English poet of considerable eminence, was born at Little Berkford, in Bedfordshire, in 1673. Having received the rudiments of his education at Highgate, he was placed as a king's scholar under the celebrated Dr. Busby of Westminster school, where he exhibited an early talent for Greek and Latin verses. He entered himself student of the Middle Temple, and was called to the bar; but being left his own master at the age of nineteen, in consequence of the death of his father, he quitted the bar, and devoted himself to a literary life.

His first work was the tragedy of the *Ambitious Stepmother*, which was published in 1698, and was well received when it was performed at Lincolns Inn Fields. His next piece was *Tamerlane*, the object of which was to give favourable impressions of civil and religious liberty. It was frequently acted in 1702 and in succeeding years, till 1710, when it was for a while intermitted. It was, however, revived at the accession of the house of Hanover, and was for many years performed on King William's anniversary. His *Fair Penitent*, considered as his *chef d'oeuvre*, appeared in 1707. In 1706 he produced the comedy of the *Biter*; but it was such a failure that it was not inserted among his works. Between 1706 and 1715, he published in succession the tragedies of *Ulysses*, *The Royal Convert*, *Jane Shore*, and *Lady Jane Gray*, of which *Jane Shore* is still occasionally acted, and always admired. Mr. Rowe likewise published an edition of Shakespeare, to which he prefixed a life of the poet. One of the most important, however, of Mr. Rowe's works was his Translation of Lucan's Pharsalia, which did not appear till after his death. He translated also the Golden Verses of Pythagoras, and the first book of Quillet's Callipædia.

Mr. Rowe was appointed under-secretary of state to the Duke of Queensberry, but he held this situation only three years, till the death of the duke. On the accession of George I. he was made poet laureate; he was appointed also one of the land surveyors of the customs of the port of London; the Prince of Wales gave him the clerkship of the council, and the Lord Chancellor Parker made him his secretary for the presentations. These accessions to his fortune enabled him to live very comfortably; but he did not enjoy them long. He died on the 6th December 1718, in the 45th year of his age, and was interred in the poet's corner, Westminster abbey, opposite to Chaucer. The "Poetical Works" of Mr. Rowe, containing his plays and miscellaneous poems, were collected and published in 1719, in three vols. 12mo.

ROWLEY. See Chatterton, Vol. V. p. 755.

ROXBURGHSHIRE. This county evidently derives its name from the ancient city and castle of Roxburgh, which stood in the beautiful peninsula formed by the junction of the Tweed and Teviot, opposite to Kelso, but of which scarcely a vestige now remains. It is also sometimes called Teviotdale, as the river Teviot rises in its western extremity, and flows through the county in a north-easterly direction, till it unites with the Tweed at Kelso, which is within four miles of the eastern extremity. There is indeed a district in the county towards its southern point, called Liddisdale, from the stream Liddal, which runs through it from north to south. But, speaking in a general way, the name of Teviotdale is often given to the whole county. The parish of Castletown comprehends all Liddisdale, is about fifteen miles from north to south, and though it varies much in breadth, may be about twelve miles in its greatest extent from east to west. Roxburghshire is situated between 55° 7′ and 55° 42′ North Lat. and nearly between 2° 10′ and 3° 8′ West Long. from London. Its form is very irregular, particularly towards the south and north extremities, which run so much into adjoining counties, as to render it a difficult matter distinctly to fix the limits of each. It is bounded on the north by the county of Berwick; on the east by Northumberland; on the south by Cumberland and Dumfries-shire; on the west by Dumfries-shire and Selkirkshire; and on the north-west by Selkirkshire, and a small portion of Mid-Lothian. It varies much in its dimensions. Its greatest length is about 41 miles, measuring from the junction of the Mare burn with Liddal, to that of Carham burn with Tweed; and its greatest breadth, by a line crossing the above at right angles, is about thirty miles. The late Dr. Douglas of Galashiels, in his agricultural survey of this county, prepared in 1796, and published in 1798, states its medium length at about thirty miles, and its medium breadth a little more than twenty-two miles, making its contents nearly 672 square miles, and 430,080 square acres, of which about three-fifths were in sheep pasture, and the remaining two-fifths were under the plough, except about 8000 acres occupied in woods, pleasure grounds, towns, and villages. Though some subsequent accounts in gazetteers, &c. vary considerably in certain of these calculations, yet, as we well know the remarkable accuracy of the Reverend Doctor, and that there has been no general agricultural survey of the county since that time, we think it safer, except in cases in which we have particular data of our own, to take him chiefly for our authority in matters like these, than to trust to the unauthenticated statements of anonymous publications, which are too often loosely and carelessly given. At the same time it is proper to mention, that there has been a great extension of improved and cultivated, as well as of planted land in the county since that period, though we do not pretend to be able to estimate its amount. The late Duke James of Roxburghe, who died at an advanced age in July, 1823, a few years previous to his decease planted a great part of the extensive and unsheltered waste called Caverton-Edge, in the parish of Eckford, and other lands in Roxburgh parish, &c. amounting in all to about 500 acres. He transferred Kelso races, which had long been held there, to the Berry-Moss, which he transformed into a beautiful course, and on which he erected a very commodious and elegant race-stand.

Tweed.

Teviot.

Roxburghshire contains twenty-nine complete parishes, and a part of four others, viz. Roberton, Ashkirk, Selkirk, and Galashiels. The river Tweed, issuing from a mountain spring near the southern extremity of Peebles-shire, and almost contiguous to the sources of the Clyde and Annan, enters the county at its confluence with the Gala, a little below Abbotsford, having formed its boundary with Selkirkshire from below Sunderland Hall. Passing Melrose at the base of the Eildon hills, and receiving the Leader at Drygrange bridge, it flows through the finely wooded scenery of old Melrose, Dryburgh Abbey, Merton, Makerston, and Fleurs, where it reaches Kelso, to the beauty of the scenery of which place its confluence with the Teviot richly contributes. Thence it proceeds through a more level but richly cultivated district, and becomes in its progress the boundary between England and Scotland. The part of the Tweed within Roxburghshire is crossed by three stone bridges, viz. at Darnick, a mile above Melrose, at Drygrange, two miles below Melrose, and at Kelso;* also by two iron suspension bridges, one about 300 feet in span, now erecting (1825) between Melrose and Gattonside, and the other at Dryburgh for foot passengers and single horses. The Teviot, which may be truly called a county river, rises many miles south of the Tweed, and taking a north-easterly course to Kelso, seems pretty nearly to divide the county into two equal parts. The division lying north of the Teviot contains the greater proportion of the arable land of the county, the south-eastern and the southern part of the other division being very mountainous.

The surface of the county is finely diversified, and exhibits many scenes that are beautiful and romantic; while the historical and poetical associations connected with the course of its rivers, and their tributary streams, confer upon it, in the eye of the scholar and antiquary, peculiar charms. No county in the kingdom perhaps is better watered, or enjoys more numerous or beautiful streams and brooks. One or more of these meanders through almost every little vale. The Teviot receives in its course the Allan, the Slittrige, and the Rule, all of which rise on the confines of Liddisdale. The Ale and Borthwick are the northern feeders of the Teviot. Both rise in Selkirkshire, and are in some places boundaries of the two counties. The Ale, after flowing upwards of twelve miles, falls into the Teviot amidst the romantic scenery of Ancrum. The Borthwick, passing through a more pastoral country, discharges itself into the Teviot above Hawick. In its farther progress, the Teviot receives the Kale, the Oxnam, and the Jed. Of these, the first and last issue from the border hills. The Jed, rushing along a rocky channel, through narrow and thickly wooded vales, and through some most picturesque scenery in the neighbourhood of Jedburgh, passes that county town, and, at the commencement of an extensive plain near Crailing, empties itself into the Teviot. Bowmont is a pastoral rivulet, which has its source in the south-east of this county, and after a rapid course of nine or ten miles, passes into England at an eastern extremity of the parish of Yetholm. The Hermitage, which runs in the south-eastern declivity of the ridge, whence Allan and Slittrige proceed in an opposite direction, tumbles over a bottom of rough stones, in the midst of green hills, whose base is generally skirted with copsewood. Passing southward, it loses itself in the Liddal, after embellishing the scenery of that detached portion of the county, called Liddisdale. The Liddal is a more placid stream, which issuing from a kind of morass, not improperly called Dead Water, comes through a district more marshy and level. After its junction with the Hermitage the Liddal is increased by some considerable brooks, and with a velocity which, in the course of time, has excavated beds for pools of an uncommon depth, descends southward through vallies capable of high cultivation, till it reaches, as we formerly noticed, the southmost point of the county, dividing Cumberland from Dumfries-shire, where, mingling with the river Esk, its waters are carried westward into the Solway Frith. In an inland county, whose lowest point is above twenty miles from the sea, the quantity of salmon is greater than might be expected, though of late years it has been much diminished, owing to the mode of fishing adopted within tide-mark.

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* See our article Bridge, Vol. IV. p. 486. and Rennie, in this volume, p. 335.

The aspect of the county is finely variegated in respect of surface and elevation. The land on the two sides of the Tweed, as that river advances toward Kelso, rises gradually toward the north, till the prospect terminates with the range of the Lammermuir hills, extending from Berwickshire to the Lothians.

There are several springs in the county, more or less impregnated with iron and sulphur; one in particular of a sulphureous nature in the morass called Dead Water, at the source of the Liddal, to which invalids frequently repair. There is one of a somewhat petrifying quality in Liddisdale, and another in the parish of Roxburgh. Iron stones are frequently seen near the surface, and fragments of agate, jasper, and rock crystal, are often found, particularly at Robert's Linne, towards the southern part of the parish of Hobkirk, near Liddisdale.

It appears from Dr. Douglas' agricultural survey, that between 1760 and 1770, coal was discovered on the hill called Carter Fell, in this county, near the border of Northumberland; but though wrought for some time, it was abandoned as of little value. Another seam of better quality was subsequently found near the southern point of Liddisdale, from which little benefit has been derived beyond that detached district. Various attempts have been made to discover coal in different places of the county; but not one of them was conducted upon a scale adequate to the importance of the object. Last season a new seam of coal was discovered on the Carter; in consequence of which a cart-load, the first fruits of the mine, was burned in triumph in the market-place of Jedburgh, whose inhabitants, from their vicinity, are chiefly concerned in its success; and some indeed of whom have an interest as proprietors. Many hands were employed during this summer, (1825,) in making roads from the site of the coal to the neighbouring turnpikes; and as there is good limestone in the vicinity, it would be an object of great agricultural importance to the district, that the experiment should prosper. Meanwhile the inhabitants of the western parts of the county in general, bring their coal from the Lothians and Dumfries-shire; and those in the eastern parts of the county, principally from Northumberland and North Durham, at distances varying from perhaps sixteen to thirty miles and upward. Under such circumstances of disadvantage, the high cultivation of the county may well be considered astonishing. Through the whole of Liddisdale limestone abounds; but, from the state of the roads, the difficulty of access, and the elevation of the ground, little is calcined for general sale. Great quantities of shell marl are found in the parishes adjoining Selkirkshire. Marl pits have also been found many years ago at Eckford, Ednam, and other places; and a few years ago marl, in large quantities, was found near the Berry Moss, in Kelso parish, during the operations connected with draining that morass. More recently still, a large stratum of marl in Linton Loch, near Morebattle, has been made available for the use of the public, and is now on sale. This is of great importance to farmers in the neighbourhood; as marl is found to be a manure admirably adapted for meliorating land, especially light soils; but the quantity required renders the carriage too expensive for distant use.

Quarries of freestone.

It has been said that strata of freestone run in a north-east direction, from the southern extremity of Liddisdale to the neighbourhood of Sprouston, where it is regularly quarried. This quarry has indeed been long highly valued, both for the beauty of the materials which it furnishes for building, and for the facility with which it is wrought. For the ornaments of public buildings, however, Eccles and Swinton quarries in Berwickshire are found to be more durable, as also for pavements and similar works. Arbroath stone is preferred, though its distance and expense make it a luxury. There are also freestone quarries at Denholm and Pinnacle. Different sorts of whinstone are found every where on the surface, in the beds of rivers, and in inexhaustible quarries. To the eastward of the Jed, the hills are covered with a thick sward of rich grass, and some are bare and rugged. Some of them, as the Eildonhills and Ruberslaw, rise beautifully from the plain, and most of them are verdant to their summits.

Surface and soil.

In a county so extensive and elevated, the proportion of heath and moss is inconsiderable, and these are gradually yielding, where circumstances admit, to the efforts of agricultural skill and capital. In Liddisdale, indeed, there is much mossy ground; and a large track of stubborn clay stretches from the south-west skirt of Ruberslaw to the confines of that district. But even in these districts dry and sound soil greatly predominates. In the arable land, the soil is of various quality and composition, consisting sometimes of rich loam, sometimes of sand and loam mixed, and sometimes of sand, gravel, and clay in various proportions. The loam and rich soil is generally found on low and level lands near the beds of rivers and rivulets. The heavy clayey soil chiefly occupies the higher grounds; the largest part of it is immediately south of Eildon hills, including the parishes of Minto, Lilliesleaf, Bowden, Melrose, and a part of Ancrum, Maxton, and Roxburgh. The extent of the district of clay is supposed to be about 10,000 acres, of which about one-eighth part may have been planted. About one-half of the remaining part of this heavy soil bears luxuriant crops of wheat and other produce. In the parishes north of Tweed, near Kelso, heavy soil is rather most prevalent, and is in general of good quality. Another portion of it runs along the higher grounds south of Tweed, near Kelso.

Progress and present state of agriculture.

At the first Roman invasion of this part of the kingdom, it appears to have been in a state of uncultivated nature, covered with impervious woods and dreary wastes; and the civilized invaders did little for the improvement of the soil, except around their encampments. The Saxons, in a later age, partially cut down the woods, and cultivated the land; but it was not till the reign of David I. that something like a plan of systematic cultivation was adopted. During the reign of Malcolm IV. the land was partially enclosed and improved; and the most skilful husbandmen of those times in this county were the monks, especially those of Kelso, who possessed extensive property. The civil wars by which Scotland was long distracted, as well as the frequent wars between Scotland and England, retarded agricultural and every other species of improvement; and the Borders, which were the focus of hostile contention, were peculiarly liable to devastation. We must therefore date the substantial improvement of agriculture from the union of the crowns, when property became more secure. But it was not till after the revolution of 1686, and especially till after the union, that property acquired real stability. Since that time the change has been wonderful indeed, and this county, which has taken a lead in agricultural improvements, may now be ranked among the best cultivated parts of the kingdom; and the valued rent of it is believed to be greater in proportion to its extent than that of any other in Scotland. It amounts to £314,668, 6s. 4d. Scotch. The principal proprietors are the Dukes of Roxburgh and Buccleugh, the Marquises of Lothian and Tweeddale, Lord Minto, and the families of Scot, Ker, Douglas, Pringle, Rutherford, &c. The number of freeholders at present on the roll is 139, a great majority of whom possess real property in the county.

Leases.

Leases of arable lands are in general of nineteen or twenty-one years duration. Pasture farms, admitting comparatively little improvement, are still sometimes let for a shorter period. In the leases of arable lands, provision is in general made for preventing them from being impoverished by injudicious or severe cropping, especially toward the close. The common restrictions are, that a certain portion of the farm shall be left in grass or in fallow; that the straw and manure produced during the currency of the lease, shall be consumed on the ground; and that two white crops shall not be raised without the intervention of a green crop or fallow. The enclosure of lands occasions special stipulations in leases. The fences are sometimes kept up at the mutual expense of landlord and tenant, sometimes formed by the landlord, who is entitled to receive a certain rate of interest for his outlay, and they are then kept in repair by the tenant. Practices somewhat similar apply to the lime laid on the land, of which the quantity amounts to about eight single horse cartloads, or 160 bushels per English acre. The time of entrance to farms is generally at Whitsunday, and to such parts as are in crop at the separation of the corn from the ground. The rents are generally made payable at Martinmas and Whitsunday, but are rarely exacted till near Candlemas or Lammas following. Leases for one or more lives, though they sometimes occurred formerly, are now very rare. The size of arable farms may vary from 50 to 1500 acres, and may average from 300 to 400 acres. Several farms bring from £1500 to £2000 per annum; one gentleman, indeed, occupies land to the extent of above £5000 per annum. Farm-houses and offices, which are now generally made very commodious, are usually put in good repair by the proprietor at the commencement of the lease, and kept up by the tenant.

Size and rent of farms.

An improved system of draining, enclosing, and cropping, is said to have been introduced by Dr. John Rutherford about eighty years ago. At a late period, viz. about 1750, Mr. William Dawson commenced farming in the county of Roxburgh, was among the first to introduce turnip and drill husbandry from Norfolk, and exhibited a most useful and successful example in all the branches of agriculture. Still more recently, the present four-break system of husbandry became general in this county.

In 1813 the Border Agricultural Society was formed, which have a spring and autumn meeting in Kelso, for the exhibition of stock and machinery, and for the distribution of various prizes. It has been conducted with remarkable spirit and success. In 1820, this society formed a junction with another institution of the same kind, whose meetings were held at Coldstream and Cornhill, and which was called the "Tweedside Agricultural Society." The name of the association after the junction was the "Union Agricultural Society," whose meetings are now held two years in succession at Kelso, and one year at Coldstream or Cornhill. Regular cattle markets under its auspices, have been established at Kelso and Coldstream during part of the winter and spring months; and these have tended both to improve the stock, and to add to the profits of breeders. Distinguished amateurs in the higher ranks frequently attend the exhibitions of the society; and the show of home-reared cattle, especially of the short-horned breed, excites admiration both for number and excellence. The small hook, sometimes with a smooth, sometimes with a serrated edge, still continues to be the general instrument for reaping over all this part of the country. The common long scythe is only very partially employed.

Union Ag- ricultural Society.

Weekly markets for the sale of grain, are regularly held in Kelso, Jedburgh, and Hawick, in which places corn is sold by sample on short credit. The Kelso market is by far the most numerously frequented, and is generally attended by corn dealers from the port of Berwick, who purchase for exportation to London, &c. Most of the grain produced in this fruitful district is delivered at Berwick, though a considerable proportion is conveyed to Dalkeith by land carriage, where it is always sold in bulk, and paid in ready money. One advantage of this distant conveyance is, that the superior coal and lime of Mid-Lothian are brought home in the carts. In particular seasons, some portion of the corn sold in Kelso market, which includes a considerable part of the produce of Berwickshire and Northumberland, is sent to the interior of the county westward for consumption.

Markets for grain.

There are various fairs held periodically in the county, the greatest of which is that of St. Boswell's, on the 18th of July, on an extensive plain near the Tweed, for lambs, sheep, black cattle, horses, linen, and woollen cloth. The price of wool, with the staplers who come from Yorkshire, and other parts in the south, is generally fixed here, as well as at Yetholm and the Rink fair, near Jedburgh. St. James's fair is held on the fifth of August, on the green of ancient Roxburgh, now a part of the farm of Friars, opposite to Kelso. A great deal of linen and woollen cloth is here disposed of; numerous horses and cattle are exposed to sale; and bargains are made between farmers and labourers, either from the neighbourhood, or from the Scotch Highlands and Ireland for harvest work.

Fairs.

Considering the distance of most of the inhabitants of this extensive county from fuel and markets, it is not surprising that different projects have been concerted for diminishing this inconvenience. A plan was formed above thirty years ago for making the Tweed navigable from Kelso to Berwick. But besides the objections to this measure on the part of the proprietors of the valuable fisheries near the mouth of the Tweed, the rapid inundations to which it is sometimes liable, were thought such as to render the measure inexpedient, if not impracticable. In the year 1811 an act of parliament was obtained for carrying a rail-road from Kelso to Tweedmouth, chiefly through the exertions of Hugh Scott, Esq. of Harden. Its estimated expense was about L.100,000, of which more than one half had been subscribed in shares of L.100 before the act was passed. Various unforeseen obstacles have since prevented the accomplishment of the measure. But in 1824, when speculations of every kind were so much afloat, from the overflow of unemployed capital, the subscription list was more than filled up, and plans and estimates were ordered. A new survey of the ground has been made during the present season (1825) and it is expected that early in the next spring the work will be commenced. A liberal subscription has also been recently opened for extending the line of railway from Kelso to Melrose, and thence to Mid-Lothian. But we acknowledge that we see no prospect of the extended line being speedily accomplished.

Poor rates have been long established in this border county. Dr. Douglas states the number of paupers in 1796 maintained constantly by assessment to have been 979, and the amount of the assessment L.2776. This of course excludes weekly collections at the church doors, &c. It affords at an average the small annual allowance of about L.2, 17s. to each pauper in the list. According to the supplementary report of the committee of the General Assembly in 1820, on the management of the poor in Scotland, the average annual amount of the assessment during the ten preceding years, was about L.5917. In this estimate is not included the small proportion of assessment levied on those four parishes which lie partly or chiefly in adjoining counties. The number of persons sent from England under the select vestry act of 1819, which authorises a magistrate to send vagrants to Scotland, natives of that country, who may have been in England half a century more or less, but who have not acquired what is called a settlement there, has been very severely felt. See the article Kelso, Vol. XII. p. 432. We have reason to believe that poor rates have fallen considerably in this county since the above report of the General Assembly's committee was made. One great cause of poverty through the land, is the excessive indulgence in spirituous liquors among the lower classes of Society. Some correction of this evil is loudly called for, especially when the diminished duty on home-made spirits, and the qualified permission of their passing to and from England from the 10th January next, will afford new facilities and temptations to this ruinous practice.

The population of the county according to the government census of 1821 is as follows: Males 19,408, females 21,484, total 40,892. Increase since the census of 1811 is 3662.

The county of Roxburgh contains many excellent mansions, the principal of which are Fleurs, the seat of the Duke of Roxburgh; Mounteviot, the seat of the Marquis of Lothian; Minto House, the seat of the Earl of Minto; the Pavilion, the seat of Lord Somerville; Springwood Park, the seat of Sir William Scott Douglas; Ancrum, the seat of Sir Wm. Scott; Makerston, the seat of Sir Thomas Brisbane Makdougall; Abbotsford, the seat of Sir Walter Scott; Stitchel, the seat of Sir John Pringle; Stobs, the seat of Sir William Elliot; Edgerston, the seat of Mr. Rutherfurd; Drygrange, the seat of Mr. Tod; Chesters, the seat of Mr. Ogilvie; Eildon Hall, the seat of Mr. Henderson; and Riddell House, the seat of Mr. Sprott. The most interesting of these mansions is Abbotsford, a fine Gothic castle, the internal and external decorations of which characterise it as the residence of the poet and antiquarian of Scotland. But it is not merely in his residence that Sir Walter has evinced his taste and judgment. He has covered his extensive property with the most thriving and judiciously laid out plantations; and in improving and planting his estate, he has set an example which has greatly contributed to ornament that beautiful portion of the valley of the Tweed.

Having already exceeded our ordinary limits, we must refer the reader for various particulars connected with the architectural and historical antiquities and manufactures of the county, as well as for other relative information, to the articles Hawick, Jedburgh, Kelso, Melrose, &c.

For biographical notices of some of the most distinguished characters born in this county, we refer to the articles respecting Sir John Pringle, M. D. and the contemporaneous and celebrated poets and friends James Thomson, the author of the *Seasons*, and Dr. John Armstrong. Dr. Leyden was also a native of this county, as also at an earlier period Dr. Buchan, the author of the *Domestic Medicine*. Sir William Bennet of Grubet ought likewise to be named, who, himself a lover of literature, and devoted to its pursuits, patronised Allan Ramsay, the author of the *Gentle Shepherd*, and is said to have assisted him in preparing it for the press. It would be improper to omit the notice of Robert Riccaltoun minister of Hobkirk; whose *Posthumous Theological Works*, in 3 vols. though not generally known, have some warm admirers, but whose name is better known as the early and steady friend and patron of the poet Thomson. (See Thomson.) We may also mention the name of the learned and venerable Dr. Samuel Charters, a native of Fife, and who was for more than half a century minister of Wilton, in this county. He died on the 18th day of June 1825, about the 84th year of his age. His published sermons have been long known and much admired.

Rubellite.

RUBELLITE. See Mineralogy. *Index*.

Rubens.

RUBENS, Sir Peter Paul, one of the most distinguished painters of modern times, was born at Cologne in 1577. His father, who had been a counsellor of state at Antwerp, observing the talents of his son at an early age, cultivated them with peculiar care; and by the diligence with which young Rubens availed himself of the opportunities of instruction within his reach, he made great progress in polite and classical learning. In his leisure hours he was always found occupied with drawing; but his father disregarding this indication of his peculiar talent, placed him as a page with the countess of Lalain, a situation by no means suitable to the turn of his mind, or the direction which his studies had now taken. When the death of his father released him from the obligations of filial duty, he obtained permission from his mother to devote himself to the profession of a painter.

With this view he became the disciple of Tobias Verhaecht, a landscape painter of some celebrity; but being more attached to history painting, he went to study that branch of the art under Adam Van Oort. Disgusted, however, with the vulgarity and virulence of that artist, he soon renounced his assistance, and became the disciple of Otho Venius, (Octavio Van Veen) whose temper and accomplishments were peculiarly congenial with his own. Under this excellent master, Rubens was inspired with an ardent passion for his profession. He pursued it with an ardour which knew no bounds; and such was the proficiency which he had attained, that in his 23d year, Otho acknowledged that he could give him no farther assistance, and advised him to seek for the higher accomplishments of his profession in the study of the Italian masters. In obedience to this advice, Rubens set out for Italy, with introductory letters to the duke of Mantua from the archduke Albert, governor of the Netherlands.

After having examined the productions of art at Venice, he went to Mantua, where he was warmly received by the duke, who was so delighted with his general manners and acquirements, that he appointed him one of the gentlemen of his chamber. There he had an opportunity of studying in the palace del T, the fine productions of Julio Romano, in which he took great pleasure; and after remaining in the residence of the duke for two years, he obtained permission to repair to

Venice, for the purpose of studying the works of Titian, of Paul Veronese, and of other productions which had particularly excited his notice during his short visit to that city. Imbued with an admiration of the rich and brilliant pictures of the Venetian school, Rubens executed, on his return to Mantua, three magnificent pictures for the church of the Jesuits, which have been considered as among his finest works. Desirous of having, from such an artist, copies of the most celebrated pictures at Rome, the Duke of Mantua offered him the means of pursuing his studies at that capital, and he executed the commission thus given to him with singular success.

Rubens had impressed his patron with such an opinion of his ingenuity and talents, that in 1685 the duke sent him on an embassy to the court of Spain; and while he executed the political part of his mission with ability and success, he exercised his professional talents on a picture of the king of Spain, by whom he was honoured with the most marked attention.

After returning to Mantua, he paid a second visit to Rome, where he painted three excellent pictures for the palace of Santa Maria, in Valticella. At Genoa, to which he next repaired, he received much employment. Among the pictures which he executed were two for the church of the Jesuits, viz. the Crucifixion, and Ignatius working a miracle.

Having received accounts of the illness of his mother, he performed a rapid journey to Holland; but he was not able to reach Antwerp to soothe the last moments of his parent. His spirits were much affected with her loss; but as soon as he had arranged his family concerns, and was about to set off for Italy, his earliest patron, the Archduke Albert, and the Infanta Isabella, induced him to remain at Antwerp. Here he married his first wife Elizabeth Brants, and erected a magnificent house, with a saloon, in imitation of the Rotunda at Rome, which he adorned with a choice collection of pictures, ancient statues, busts, and vases. Thus elegantly established in his native land, he executed many of those beautiful productions which have immortalized his name; but the death of his wife, after he had enjoyed her society only two years, afflicted him deeply, and forced him to seek for consolation in a journey to Holland.

The high reputation which Rubens had now acquired, and the wealth and honours which flowed in upon him with a full channel, soon excited the envy of his rivals. His success was ascribed to the skill of his pupils, to Jordaens, Van Uden, and Snyders; and he was accused by the ignorant and ill employed, of want of invention in his art. Rubens held all these marks of jealousy in the contempt which they always merit, without attempting to resist them. On the contrary, he relieved the wants of those that abused him, he procured employment to those who envied his success, and he answered the charge of poverty of invention by the finest productions in every branch of his art.

His fame had now reached the French capital, and he was requested by Mary de Medicis, queen of Henry IV. of France, to ornament the galleries of the palace of the Luxembourg. In these paintings, which have been so much admired, he has depicted in allegorical designs the leading events in the life of that princess. This series of compositions, crowded with figures, were executed in three years, amid other numerous occupations. They were all painted at Antwerp, excepting two which he executed at Paris in 1623, when he came to arrange the whole in the gallery.

During this visit to Paris, Rubens became acquainted with the Duke of Buckingham, who was then on his way to Madrid with Prince Charles. The duke was so much struck with his talents and accomplishments, that he considered him well qualified to explain to the Archduke Albert and his wife Isabella, the causes of the misunderstanding which had taken place between England and Spain. In the discharge of this duty Rubens exhibited such prudence and tact, that Isabella dispatched him as envoy to the court of Madrid to propose terms of peace. Rubens arrived in that capital in 1628, and was received with much distinction by Philip IV. After performing his political mission with success, Rubens was called upon to exercise his pictorial talents. Philip gave Rubens a commission for five pictures for the church of a convent of Carmelites, which his minister, the Duke of Olivares, had just founded at Loeches, near Madrid. Rubens speedily executed these elaborate pictures in his best style. The first was an allegorical representation of the triumph of the new law, which was personified by religion in a triumphal car, drawn by five angels, while others bore the cross; while infidelity and ignorance, under the form of slaves bound in chains, followed the triumphant equipage. The picture which was a companion to this, represents Melchisedeck offering Abraham bread and the tenth of his spoils. The other two pictures represent the four doctors of the church and the four evangelists, with the usual emblems. The king likewise engaged him to paint eight large pictures for the great saloon of the palace at Madrid. The subjects of the pictures are; the Rape of the Sabines; the battle between the Romans and Sabines; the Bath of Diana, Perseus, and Andromeda; the Rape of Helen; the Judgment of Paris; the Triumph of Bacchus; and Juno, Minerva, and Venus; and they are justly ranked among the best of his productions. He likewise painted the martyrdom of St. Andrew for the church dedicated to that apostle, and a large portrait of the king on horseback. The king was so much gratified with these displays of Rubens' talent, that he conferred upon him the honour of knighthood, and presented him with a golden key as a gentleman of his chamber.

Upon his return to Brussels in 1629, he was dispatched to England by the Infanta, to sound the disposition of the government on the subject of peace. As this mission was entirely of a private nature, Rubens concealed the powers of negotiating with which he was intrusted. He was received with much respect by Charles, who engaged him to adorn the ceiling of the banqueting house of Whitehall, upon which he painted the apotheosis of king James. The king paid frequent visits to Rubens, when he was engaged in the work; and, on one of these occasions, the artist availed himself of a proper opportunity of alluding to the subject of a peace with Spain. Having found that the English monarch was not averse to listen to the subject, Rubens produced his credentials; and some members of the council having been appointed to conduct the negotiation on the part of England, a peace was speedily concluded. Rubens was honoured by Charles with the rank of knighthood, on the 21st July 1630, and he afterwards returned to Flanders, where he was received with the honours so justly due to him, both as a diplomatist and an artist. Here he continued to enjoy his reputation, and to add to the number of his works. He married his second wife Helena Forment, who was a distinguished beauty, and who was said to be of great use to him in the execution of his female figures. When Rubens had reached the 58th year of his age, his frame, naturally strong, began to give way to repeated attacks of the gout, which compelled him to abandon his larger undertakings, and to confine himself entirely

Rufus,
Rugby.

to easel painting. He continued, however, to enjoy sufficient health to enable him to continue his professional labours till the year 1640, when he died on the 30th of May, in the 63d year of his age. His remains were interred with great pomp in the church of St. James, at Antwerp, beneath the altar of a private chapel of his own, which he had ornamented with a beautiful painting. His wife and children erected a monument to his memory, with a Latin epitaph, setting forth his virtues and his talents. He was succeeded by his son Albert, (born in 1614,) as secretary to the counsel in Flanders. This young man, though he did not inherit the peculiar talents of his father, was the author of several works on coins and medals, and other subjects of antiquarian research.

For an account of the peculiar style of Rubens, and criticisms upon his principal works, we must refer the reader to our article on PAINTING, Vol. XVI. p. 254.

RUBY. See MINERALOGY *Index*.

RUDBECK, OLAUS. See BOTANY, Vol. IV. p. 9.

RUDDIMAN, THOMAS, a celebrated Scottish writer, was born at Raggel, in the parish of Boyndie, in Banffshire, in Oct. 1674. After receiving a good classical education at the parish school, young Ruddiman was ambitious of pushing his education at college. He had heard of the annual competition at King's College, Aberdeen, for bursaries; and his father, from thinking him too young, had opposed his wishes; he resolved, without his knowledge, with only a guinea in his pocket, which his sister had privately given him, to set out for that literary city. On his road to Aberdeen he was met by a gang of gypseys, who robbed him of his coat, his stockings, his shoes, and his only guinea. Undismayed at these losses, he continued his journey, and presented himself as a candidate for one of the university bursaries; and though without friends, and almost without clothes, he succeeded in gaining the first prize.

After studying five years at the university, he took his degree of M. A. in 1694, and after spending a short time as tutor to the son of Mr. Young of Auldbar, he was appointed schoolmaster of the parish of Laurencekirk, a situation which he held for three years.

The celebrated Dr. Pitcairne happening to arrive at Laurencekirk, he was detained there the whole day by a violent storm, and inquiring at the landlady if there was any agreeable person in the village who would take part of his dinner, she recommended Mr. Ruddiman as both learned and social. The learned doctor was so much pleased with the information and manners of his guest, that he invited him to Edinburgh, and promised him his friendship and patronage.

Induced by this invitation, Ruddiman went to Edinburgh in 1700; and two years afterwards he was appointed assistant librarian to the Faculty of Advocates, with a salary of £8, 6s. 8d. Although he had some employment as a teacher, and was engaged by booksellers to assist in different literary undertakings, yet his income was so small that he commenced the business of an auctioneer in 1707. He still, however, continued his literary labours; and in the same year he published an edition of *Voluseni de Animi Tranquillitate Dialogus*, with a life of the author. In 1709, he published *Johnstoni Cantici Solomonis Paraphrasis Poetica*, and also *Johnstoni Cantica*, with notes; a work which he inscribed in verse to his patron Dr. Pitcairne. His next literary work was a new edition of Bishop Gawin Douglas's Translation of the Æneid, for which he wrote the glossary, and probably the forty-two general rules for enabling the reader to understand the language.

Ruddiman was now invited to the rectorship of the grammar school of Dundee; but the Faculty of Advocates anxious to retain him, increased his salary to £30, and thus induced him to decline the offer.

In 1714, he published his *Rudiments of the Latin Tongue*, which superseded all other books of the kind in Scotland. It was taught even in England, and still retains its place in the Scottish seminaries. In 1715, he edited *Buchanani Opera Omnia*, in 2 vols. folio, which he enriched with critical and explanatory notes, a preface, and a dissertation entitled *De Metris Buchananæis Libellus*.

In the year 1715, he commenced the business of a printer, in company with his brother, who had been regularly brought up to the profession; and some years afterwards he was appointed printer to the university.

In 1720, Ruddiman published the first part of his *Grammaticæ Latinæ Institutiones*, which was soon followed by his *Grammatical Exercises*; a work which is still used in teaching Latin in Scotland. The second part of the first of these works appeared in 1731.

In 1739, he published *Selectus Diplomatum et Numismatum Scotiæ Thesaurus*, which was a continuation of Anderson's *Diplomata et Numismata Scotiæ*.

Ruddiman and his brother became proprietors of the Caledonian Mercury newspaper in 1729, and it continued in the family till 1772.

Although our author was zealously attached to the house of Stewart, yet he took no part in the rebellion; and in 1745 he retired to the country, and occupied himself in writing *Critical Observations on Burman's Commentary on Lucan's Pharsalia*, which was soon afterwards published.

During the last years of his life, Ruddiman was almost constantly engaged in literary disputes; but he performed his part in these discussions with prudence and temper, and he considered the cause of truth to be too sacred to be abandoned, merely because he himself might be involved in controversy. His eyesight having begun to fail, he resigned the situation of librarian to the Faculty of Advocates, in 1752. He died at Edinburgh on the 19th of January, 1757, in his 83d year, and was buried in the Grey-Friars church-yard, where no monument records his talents and his virtues.

RUFUS, EPHESIUS. See ANATOMY, Vol. I. p. 735.

RUGBY, anciently *Rocheberie*, a town of England in Warwickshire, has an elevated situation on the south side of the Avon, and about a mile from the place where it receives the rivers Swift and Dove. The town is neat, and the streets, which are irregular and badly paved, are disposed in the form of a triangle. Many of the houses are of wood. The church is a commodious structure, handsomely fitted up with an organ.

This town has been long celebrated for its grammar school, founded by Laurence Sherrif, Esq. in Queen Elizabeth's reign. It is managed by twelve trustees from the nobility and gentry of the county. The property of the school is at present worth above £2000. It sends fourteen exhibitioners, with annuities of £40 each, to the universities. Vacancies are filled up at the annual examinations, which are attended by a member from both universities, appointed by the vice-chancellor. The scholars amount to 330, 50 of whom are on the foundation. A handsome and commodious building has been erected for the school since 1808. It is of white brick, while the angles, cornices, and the dressings of the windows and doors, are of stone. Sixty of the boys are lodged in this building, and the rest are accommodated at the house of the assistant master, or at boarding-houses in the town. The principal front is 220 feet long, with a tower gateway in its centre leading to the principal court, which is a fine area 90 feet long and 75 wide, with a plain cloister on three sides. On the south side of the court are the dining hall for the boys in the head master's house, and three schools for different classes; the great school occupies the west side, and the schools for French and writing the north. The house of the head master is at the east end of the south front; and there is between it and the schools a range of buildings divided into small apartments for the boys. The town contains about 278 houses, and 4490 inhabitants.

RUGEN, an island in the Baltic, belonging to Russia. It is situated opposite to Stralsund, on the coast of Pomerania, from which it is divided by a channel about a mile broad. It is about thirty miles long, and from twenty-five to thirty broad, and contains about 360 square miles. It is so much penetrated by the sea, that it resembles a number of peninsulas joined together. The two principal divisions of the island are Jasmund and Wittow. The coast, which consists in many places of chalk cliffs with petrifactions, is much higher, and more precipitous than that of Pomerania. The soil, which is very fertile, produces all kinds of grain, several thousands of lasts being shipped annually for Stralsund. Large herds of cattle are bred and exported; but it is supplied with fuel from Pomerania. Rugen does not contain any good harbour. The language of the island is German. It was long subject to Sweden; but along with the rest of Pomerania it was added to Prussia in 1814. Bergen is the capital of the island. See Bergen, Vol. III. p. 463.

RULE OF THREE, or the Golden Rule, the name of a rule in arithmetic, the object of which is to find a fourth proportional to three given numbers. As the theory of the rule has already been explained in our article Geometry, Vol. X. p. 210—214, we have only to give it in its practical form.

Rule. Set down on the right hand the one of the three given terms which is of the same kind or name as the answer required; and from the nature of the question, consider whether the answer will be greater or less than this term. If the answer is to be *greater*, place the lesser of the two remaining terms on the left, and the other in the middle; but if it is to be *less*, place the *greater* of the two other terms on the left, and the other in the middle. When this is done, *multiply* the *second* and *third* terms together, and *divide* the product by the *first* term, and the quotient will be the answer required. This rule is equally applicable to integral, fractional, and decimal numbers.

RUM is the name of an ardent spirit distilled from the sugar cane. The ingredients which are employed, are the lees or feculencies of former distillations fifty gallons; molasses or treacle drained from the sugar six gallons; scummage of the hot cane, juice from the boiling-house, (or sometimes raw cane liquor,) 36 gallons, equal to other six gallons of molasses; and water 8 gallons, making in all 100 gallons. When the above wash is fermented in the common method to a proper degree of acidity, it is distilled in the common way; and about 1200 gallons of this mixture or wash produces about 113 of rum. For a full account of the process, see Edwards's *History of the West Indies*, vol. ii.

RUM, Egg, and Muck, the name of three of the Western Islands of Scotland, in Argyllshire, situated to the west of the isle of Sky. Rum is about nine miles long, from six to eight broad, and has a superficies of 22,260 acres. It consists of a heap of mountains of the same height, the highest being about 2500 feet. Loch Scresort is its only harbour. It is subject to perpetual storms of wind and rain. Egg is six miles long and four broad. It is divided into two eminences by a valley, the one rising to high basaltic cliffs, and the other into the Scuir of Egg, 1500 feet high. Muck is a green island three miles long. The population is about 600.

RUMFORD, Count. See Thomson, Benjamin.

RUPERT, Prince. See Britain, Vol. IV. p. 584.

RUPERT'S Drops. See Annealing and Glass, Vol. X. p. 319.

RUSH, Benjamin, a celebrated American physician, was born near Bristol in Pennsylvania, on the 5th Jan. 1745. After receiving the elements of a classical education he went to the college of Princeton, where he took his degree of B. A. in 1760. He began the study of physic under Dr. Redman, of Philadelphia, and took his degree at Edinburgh in 1768, having written a thesis *De concoctione ciborum in ventriculo*.

About the period of Dr. Rush's return to Philadelphia, an attempt was made to organize a medical school in that city, and upon his arrival in 1769, he was appointed professor of chemistry. Dr. Rush was soon after elected a member of the American Philosophical Society; and in the 1st vol. of their Transactions, printed in 1770, he published his *Account of the Effects of the Stramonium, or Thorn Apple*. In 1776, he was chosen member of Congress for Pennsylvania; and on the 4th July, with eight other delegates of the state, he signed the instrument of independence. In 1777, he was appointed surgeon-general of the military hospital in the middle department, and in the same year physician general of that hospital. This situation, however, he resigned in July following; and though he for some time after took a part in the politics of the state in which he resided, yet he resolved to quit that scene of contending passions, and to devote himself to the peaceful pursuits of his profession. To this resolution he firmly adhered, and the rest of his life was passed in the most zealous discharge of his professional duties, and in the study of medical science, which at that time was in a very low condition in America.

When the medical colleges of Philadelphia were incorporated into the university of Pennsylvania in 1791, Dr. Rush was appointed professor of the institutes of medicine and clinical practice. Two years afterwards, when the yellow fever was so fatal throughout the United States, Dr. Rush devoted his whole mind to the investigation of the disease, and published in 1794, in one vol. 8vo. his *History of the Yellow Fever*, which was celebrated for its minute and correct account of the disease.

Having published many papers in various works, Dr. Rush collected them in 1788, under the title of *Medical Inquiries and Observations*, of which the fifth volume appeared in 1798. The last work of any importance which Dr. Rush published, was *On the Diseases of the Mind*, which appeared in one volume 8vo. in 1812.

Dr. Rush had been threatened with consumption during the greater part of his life; but he had warded off its attacks with great skill. On the 13th April he was seized with a slight affection of his lungs. His disease, however, assumed a typhus character, and, after an illness of five days, he died on the 19th April 1813, in the 69th year of his age.

Dr. Rush was the author of a great many pamphlets and essays, the most important of which have been preserved in his *Medical Inquiries and Observations*. See the *American Medical Philadelphia Register*, by Dr. Hosack and Dr. Francis; Chalmers's *Biographical Dictionary*, vol. xxv.; and Rees's *Cyclopædia*.

RUSSIA.

GENERAL HISTORY.

us of In treating of the history of Russia some authors have adopted regular plans. The learned and famous Schlœtzer divided Russian history into five great periods. He was of opinion, 1st, That Russia, from the year 862 till the time of Sviatopolk, ought to be named *commencing* (nascens): 2d, From the time of Yarsalaf till the Mogoles, *divided* (divisa): 3d, From the time of Batii till Iván III. *oppressed* (oppressa): 4th, From Ivan III. till the time of Peter the Great, *victorious* (victrix): 5th, From Peter the Great till Catharine the 2d, *flourishing.* But Karamzin thinks this division is rather ingenious than well founded, because, 1st, The age of Vladimir was already an age of power and fame, and not of *birth*: 2d, The kingdom was also formed before the year 1015: 3d, If, according to her internal situation, and her external operations, it be necessary to mark periods, can we associate the time of the great Duke Dmitrii Alexandrovitch and of Dmitrii Donskoi? passive slavery, with victory and fame? 4th, The time of the usurpers is more characterised by misfortune than by victory. The same author is likewise of opinion that it would be much better, and more just, to divide Russian history into, 1st, *ancient*, from Rurik to Iván the III.; 2d, *middle*, from Iván III. to Peter the Great; and, 3d, *modern*, from Peter the Great to Alexander I. The system of appanage was the character of the first epoch; monarchy of the second; and the change of civil customs of the third. In our sketch of the history of Russia, we do not deem it necessary to adopt any divisions.

of ire. The origin of the Russian empire is involved in great obscurity.* A herd of the Slavi, Slavonians, or as they are oftener called, Sclavonians, who had advanced from the banks of the Danube, and were wandering upon those of the Dnéper, are supposed to have fixed themselves about the 5th century, in the region now occupied by the government of Kiéf, and to have built their capital, which is still known by the same name. It is also conjectured that another tribe of the Slavi fixed themselves on the Volchof, and founded the well-known city of Novgórod. Of neither tribe do we possess any regular accounts till about the middle of the 9th century. According to the Russian historians the Slavi were completely subjected about the year 860, by the Varages, or Varagians, a piratical nation who dwelt upon the coasts of the Baltic, under their leader, Rurik, who established the seat of his government, near the Volchof, at a place called Old Ladoga, and who, with two other chiefs, governed the conquered provinces. From this period may be dated the commencement of the Russian monarchy.

In the year 865, the Slavi flew to arms, and made a brave but vain attempt to regain their independence. Emboldened by success, Rurik extended his territories, and fixed the seat of his government at Novgórod, which was already a large city. Soon afterwards, by the death of his copartners in the goverment, Rurik became sole ruler of the conquered territories, reigned over them seventeen years in tranquillity, and became the primogenitor of a long line of descendants, who swayed the sceptre for several centuries. Rurik assumed the title of *Velikii Kniaz*, or Great Duke. His territories were of considerable magnitude, and to them he recalled his countrymen the Varagians.

Rurik.

Igor. 882.

At his death, his only son Igor, was a minor; and Oleg, a kinsman of the deceased sovereign, took upon himself the administration of affairs. Endowed with a martial spirit, and ambitious of military fame, or of conquest, he collected a numerous army, marched to the south, and after reducing several towns, reached Kiéf, which he got possession of, after treacherously and barbarously murdering Oskhold, and Dir, the two chieftains of the Kiévians. Kiéf then became the capital of Russia. In 886 Oleg defeated the Drevlians, the Severyani, and the Raditmitchei. In 900 the ambitious Oleg next projected and successfully executed an expedition to Constantinople. With 80,000 troops, on board of 2000 vessels, he sailed, by the Dnéper, to the Black Sea, and from thence to that capital, and triumphed over Leo, who then swayed the sceptre of the Grecian empire. He returned loaded with immense booty, and so astonished the people that they imagined him endowed with supernatural powers. During the thirty-three years which Oleg maintained the sovereign power, it appears that his administration was well regulated. He is said to have built many towns.

886.

On the death of his guardian, in 913, Igor took possession of the throne at the age of forty. Endowed with the same warlike spirit as Oleg, after having quieted different rebellions, and vanquished the Drevlians, the Uglitchis, and the Petchenegues, Igor planned a second expedition against Constantinople, and, according to the Russian annals, which are no doubt extravagant, equipped an army of 400,000 warriors. In the year 941, he set sail with this great army for Constantinople without having made any declaration of war, and without any ostensible motive for infringing the treaty of peace which had been entered into by Oleg and Leo. For this conduct he was severely punished. He was met by the Grecian forces, under able generals; attacked both on land and in his ships; and completely defeated. Scarcely a third of the army returned with him to his own country. Nothwithstanding his bad fortune, with an undaunted spirit, and with new forces, he set out a second time for Greece; but before he had advanced beyond the Tauridan Chersonnesus, he was met by deputies from the Emperor Romanus, who offered to pay the same tribute to him as to his predecessor. Igor then retired with his army, and was afterwards put to death by the Drevlians, against whom he waged war, because they had refused to pay an augmentation of yearly tribute. Igor left one son by his spouse Olga, a princess of a bold and daring spirit. As Sviatoslaf was very young, Olga assumed the reins of Government, and in revenge for the death of Igor, took possession of the capital

913.

915.

941.

944.

945.

Sviatoslaf.

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* The learned and venerable Roman Catholic metropolitan Sestrenervitz de Bohuja, author of an elaborate work, "*Recherches sur l'origine des Slaves,*" &c. considers the Russians as of Moorish origin, and of the same tribe with the Pelasgi.

(Ikorest, or Koristen), of the Drevlians, and committed the most barbarous outrages and cruelties upon the people. But in the opinion of her panegyrists, Olga Sviatoslaf. attempted to introduce the Christian religion into the Russian territories. She undertook a journey to Constantinople, about the middle of the tenth century, when she was baptized, the Emperor Constantine Porphyrogenitus himself having conducted her to the baptismal font; and in the character of her sponsor, having given her the name of Helen. After she had ceased to rule, she persuaded her son to embrace the Christian religion, but he disregarded her solicitations. Nevertheless, a few proselytes were made among the people.

Olga appears to have been a woman of considerable talents, and to have infused useful instruction into her sex. She has long occupied a distinguished place among the Russian saints.

Sviatoslaf, who had been in possession of the government long before his mother's death, was quite a military character. He passed his life in the camp, inured himself to every kind of privation and hardship, and in fact denied himself every accommodation except what he could enjoy in common with his soldiers. By this conduct, he ingratiated himself with his troops, and then carried them against the Khosars, whom he 964. completely defeated. The emperor Nicephorus Phocas, being harassed by the Ungrians, who were assisted by his treacherous allies the Bulgarians, applied to Sviatoslaf for assistance. A treaty having been entered into, Sviatoslaf advanced with a numerous army, and made himself master of most of the Bulgarian towns along the Danube. He was obliged, however, to retrace his steps, in consequence of the invasion of his territories by the Petchenegues, whom he afterwards completely defeated. He now resumed a former design of establishing himself upon the banks of the Danube, and divided his hereditary dominions among his children. 970. He gave Kiéf to Yaropolk, the territory of the Drevlians to Oleg, and the government of Novgórod to Vladimir; a natural son born to him by one of the attendants of Olga. After a defeat, he was ultimately successful over the Bulgarians, but he was overcome by a Grecian army, which was sent against him in consequence of his having acted like a master, and not 972. like an ally. Subsequently he suffered another defeat 973. from the Petchenegues, and was killed. Yaropolk vanquished his brother Oleg, and afterwards he himself Vladimir. was slain, when Vladimir, prince of northern Russia, acquired the undivided possession of all his father's territories, which he widely extended, and became one of the most distinguished monarchs of the age. He carried on a successful war with Poland. By his vic-981. tories, he extended and enriched his empire, and esta-986. blished the Christian religion, which had hitherto made little progress in his dominions. He himself was baptized by the name of Basilius, and was married to the sister (or the niece) of the Grecian emperors Basilius and Constantine. If we can credit history, after his conversion he became quite another man, and led an exemplary life of virtue and religion. The establishment of Christianity, and with it of arts and sciences, commerce, and schools, forms the most memorable event in the life of Vladimir, (and one of the most important in the history of Russia,) who, considering the time in which he lived, has with considerable justice been called *Vladimir the Great*. In his old age, he marched against a rebellious son, on whom he had bestowed the government of Novgórod; but he died of grief upon the road after a long and glorious reign of thirty-five years.

Before his death, Vladimir had divided his extensive dominions among his twelve sons, whom he had had by four wives, reserving to himself and his immediate heir the grand principality of Kiéf. The consequences of this ill-judged distribution were dreadful. Disunion, contention, and almost perpetual warfare existed among his descendants. Sviatopolk ordered his brother Boris, who had a right to the throne, to be assassinated in 1015, as also his cousins Gleb and Sviatoslaf. In 1016, being deprived of the throne by Yarosláf, he had recourse to Boleslaus, king of Poland, and his father-in-law for assistance. He ravaged Kiéf and its neighbourhood in the year 1018, and reascended the throne. But soon afterwards he was obliged to fly, when Yarosláf again took his place. In 1026, the principality of Tmutarakán (ancient Phanagoria, and now Tamán) was joined to Russia. Different wars were maintained with the Greeks. Yarosláf formed the first code of laws in his country, known under the appellation of "Russian Code." In the year 1037, he ordered Ilarin to be consecrated metropolitan of Kiéf, without the consent of the patriarch of Constantinople; and in 1053, the Greek church separated itself from the Roman Catholic church. In 1054 Yarosláf joined together the two most powerful principalities, those of Kiéf and Novgórod, and soon afterwards he died, as is supposed, after a reign of thirty-five years. Like his father, he also divided his territories among his five sons, and the same consequences followed. Isyaslaf, his eldest son, and great duke of Kiéf, was once expelled from his dominions, but received them again, and reigned till the year 1078. From the death of Yarosláf to the beginning of the thirteenth century, the history of Russia comprises little else than a series of intestine commotions and petty warfares with the neighbouring states. The system of dismemberment of the dominions was imprudently continued by the princes at their death, and was attended with the same melancholy results. During this period, there were not fewer than seventeen independent principalities, which were afterwards reduced to seven, viz. those of Kiéf, Novgórod, Smolensk, Vladimir, Tver, Galitch, and Moscow. Of these Kiéf and Novgórod long continued to be the most powerful, though they could not always maintain their superiority over the other principalities. Vladimir also became a grand principality and as powerful as Kiéf and Novgórod. The names of the various princes who were in power during the above period, especially as there were one, two, and three of the same name, make a long catalogue. Among them occur Isyaslaf, Vseslaf, Vsevolode, Sviatopolk, Vladimir, surnamed Monomach, Mstislaf, Igor, Georgii, Rostislaf, Andrei Bogholyubskii, who made Vladimir his capital, Michail, Constantine, &c.

The Poles and the Hungarians took advantage of the intestine broils that attended the dismemberment of the Russian monarchy, and made several successful inroads. The Tartars likewise made different irruptions into Russia, and at length, under the Khan Batii completely overran it, and made themselves masters of Kiéf and Novgórod. Although the khan did not himself assume the nominal dignity, he may be said to have been sovereign, as he placed on the throne any of the native princes whom he pleased. Among a succession of these, Alexander Yarosláviteh, prince of Novgórod was by far the most distinguished. He was installed Great Duke of Russia by the Tartar Khan in 1252, and continued to reign till 1264. A victory which he had gained over the Livonians and the Swedes in 1240, on the banks of the river Neva, procured him the honourable sirname of Nevskii. He is one of the tutelary saints of the Russo-Greek church, and his memory is held at this day in the greatest veneration. After him followed a number of other princes, as Yarosláf III. Vassilii I. Dmitrii II. Andrei III. Daniel, Georgii, Dmitrii, Alexander II. &c. &c. whose times, like the past, had been disturbed by internal commotions, and trifling warfares.

In 1328, Iván Danilovitch, sirnamed *Kalita*, received the principalities of Vladimir and Moscow from the Tartar Khan, and Moscow was then declared to be the capital of all Russia. This city had been founded in 1147, but was greatly improved, especially the Kremle by Iván, who also established the dignity of metropolitan, and founded the cathedrals of the Assumption, of St. Michael, and of the Transfiguration in this city. He was succeeded in 1353 by Iván II. whose reign which had been very tranquil, terminated with his death, by the plague, in 1358. An intrigue of ten years followed, and was accompanied with its common evils. About the year 1362 Dmitrii obtained the great principality from Hildir, Khan of the Tartars. After a reign of about two years he was deposed, and it was given to the true heir Dmitrii Donskoi.

Dmitrii Donskoi was son of Iván II. His reign lasted twenty-six years with fame and glory. He is not reckoned to have had great talents, but many virtues, and to have been beloved of his subjects. He became so powerful as to have received the homage of almost all the Russian princes. Proud of the increase of his own power, and despising the weakness of his rivals, he refused to pay tribute to the Tartars. War was the consequence between him and Mamai, the khan. A dreadful battle was fought on the Don, in which Dmitrii, after various success, was ultimately successful, and hence received the sirname *Donskoi*. He had the misfortune, however, to see Moscow taken and burned by the Tartars under Tachtamish, in the year 1382, when most of the inhabitants perished by fire, water, or the sword, and the rest were made prisoners. He died in 1389, and was succeeded by his son Vassilii (II.) During his reign the Tartars made another incursion into Russia, under the famous Timur, or Tamerlane, who, after having subdued all the neighbouring Tartar hordes, extended his conquests to the Russian territories, took Moscow by assault, and carried off immense plunder. During this sovereign's reign Russia three times experienced the horrors of the plague, and oftener than once was exposed to famine. Vassilii died in 1425, and was succeeded by his son Vassilii III. sirnamed the Blind, who twice lost his throne, was re-established upon it, and died after a reign of thirty-seven years.

The latter end of the fifteenth century forms a splendid epoch in the history of Russia. From 1462 to 1505 reigned the famous prince Iván Vassilievitch, who, in a second marriage, espoused Sophia, daughter of Thomas Paleologus. At her instigation he shook off the Tartar yoke, attacked their territories, and made himself master of Kazán, where he was solemnly crowned. This last event took place about the year 1470, and led to a complete emancipation from the dominion of the Tartars. He extended his territories immensely, and subjected Novgórod after a seven years siege, and there obtained immense treasures. In his reign, the knowledge of gun-powder, and the art of casting cannon were introduced into Russia by Aristotle of Bologna, who, along with other foreigners, was employed to recoin the Russian money. Aristotle, Solarius, and others, at a vast expence, enclosed the Kremles of Moscow and Novgórod with thick walls, for the sake of greater security. After a reign of forty-three years, Iván was murdered or died, in the 60th year of his age.

Vassilii IV.
1505.

Iván IV.

In the year 1505, his son Vassilii IV. sirnamed the Courageous, ascended his father's throne. The Tartars not only revolted, but with a mighty force entered Russia, and carried their arms even to the gates of Moscow, and forced the sovereign to make presents, and give a promise of renewed allegiance. Soon afterwards, however, Vassilii recovered Kazán, as well as Pskof, a town which possessed considerable commerce and wealth. Under his reign all the principalities of Russia were united, and they have ever since remained under the dominion of one sovereign. After a reign of twenty-eight years Vassilii died, and was succeeded by his son Iván (IV.) Vassilievitch, who was afterwards sirnamed the *Terrible*, and by foreigners, the *Tyrant*. As he was only three years old, the queen-mother was appointed regent during his minority, an office for which she did not possess the requisite talents. She died in 1538, and afterwards when Iván had attained his seventeenth year, he assumed the reins of government, secured the domestic tranquillity of his dominions, made himself master of the kingdoms of Kazán and Astrachán, and liberated for ever his country from the thraldom of the Tartars. In the year 1750, the inhabitants of Novgórod were suspected of having formed a conspiracy for surrendering the city and the surrounding territory into the hands of the king of Poland, and they dearly felt the effects of Iván's vengeance; 25,000 of those who were implicated in the plot, having suffered by the hands of the executioner. With justice, therefore, this monarch was named the *Terrible* or the *Tyrant*. He was at great pains, however, to adopt measures for the improvement and civilization of his people, and his new code of laws called the *Soodébnik*, is well known even at this day. He sent an embassy to the emperor of Germany, on purpose to request him to permit a number of German artists, mechanics, and literary characters to establish themselves in Russia; but in consequence of measures taken by the jealous inhabitants of Lubeck, few of them reached Moscow. Iván engaged in a war with Sweden, for the possession of Finland, in which he reaped little advantage. He invited some Englishmen to Moscow, who, when on a voyage of discovery, had landed on the shores of the White Sea, near the situation of Archangel, and treated them in the kindest manner. In consequence of this, and of his great esteem for the English, a new commerce was established between Russia and England: In the reign of Iván Siberia was also conquered by the brave Yermák with his band of plunderers, and afterwards presented to the *Tsar*, a title which, according to some accounts, he was the first to assume. But he also endured reverses. In his time, Russia was invaded by the Tartars, and even Moscow was plundered and completely burned, and above 120,000 citizens, besides women and children and foreigners, were also burned or buried in the ruins. The Livonians, Poles, and Swedes, having united in a league against the Russians, gained great advantages over them; but peace afterwards ensued. Soon after these events the tsar was defeated in an engage-

Pheodor. 1584. ment with the Tartars, and died in the year 1584, when his eldest son Pheodor, a weak prince, became possessor of the throne. He had married the sister of Boris Godûnof, a man of great ambition, immense riches, and considerable talents, and who aimed at the imperial dignity, which he ultimately attained. The young prince Dmitrii, only brother of Pheodor, suddenly disappeared, and it is generally supposed that he was assassinated by order of Boris. 1598. Pheodor soon afterwards died, in 1598; and it was strongly suspected that he had been poisoned by his brother-in-law. With him ended the family of Rurik, a dynasty which had possessed the sovereign power in Russia ever since the establishment of the principality by that Varagian chief. As there was now no hereditary successor to the vacant throne, by the artifice and intrigues of his partisans, Boris Godûnof, succeeded in his place of being elected tsar; an honour of which he proved himself not unworthy, if we could overlook the means by which he ascended the throne. In every way he endeavoured to advance the interests of his nation, and to improve the state of his people, as by the extension of commerce, and the encouragement of arts and sciences and manufactures. He made himself respected abroad, and received ambassadors from almost all the powers of Europe, and concluded an advantageous alliance with Sweden. His reign, however, was rendered unhappy by one of the most dreadful famines on record, and by the successful operations of Otrepief, a monk, who represented himself as the *murdered Dmitrii*, the son of the late tsar, and the heir of the crown. Boris, unable to resist the torrent of public opinion in favour of his rival, is said to have taken poison, which caused his death in the year 1605. 1605. Though his son Pheodor was placed upon the throne by the principal nobility, yet the party of the *false Dmitrii*, as he is generally called, was so strong, that the new tsar was dethroned, within six weeks after his accession, and with his mother and sister was sent to prison.

Otrepief had now attained the summit of his ambitious hopes, and made his entry into Moscow with the utmost magnificence, attended by his Russian adherents and his Polish friends. He is said to have caused the death of the dethroned Pheodor, as well as that of his sister by strangulation. The new tsar, though he possessed abilities, lost the hearts of the Russians by his extreme imprudence, and at length turned them against him. The populace, incensed by the clergy, declaimed against Dmitrii as an heretic, and Shuiskii, a nobleman, who had been condemned to death by the tsar, but had afterwards been pardoned, put himself at the head of the enraged mob, and attacked the tsar's palace. Dmitrii, as well as his closest adherents, 1606. were killed. By interest, cunning, and intrigue, Vassilii Shuiskii secured his *election*, as the Russian historians affect to call it, to the vacant throne. His reign was short, uninteresting, and greatly disturbed by factions, and by the pretensions of other two factitious Dmitriis, who successively declared themselves to be either the late tsar, or the prince whom he had caused to be assassinated. While the country was in confusion, and quite distracted, Russia was invaded by the Poles, who deposed Shuiskii, made him prisoner, and sent him to Poland, where he died in the year 1612. His fate excited little regret, because of the false part he had acted toward Otrepief, who had saved his life, although himself an usurper.

The state of Russia at the beginning of the seventeenth century, was at first most melancholy, but afterwards most glorious. One usurper followed another. Shuiskii was deposed and a prisoner; Moscow, without a sovereign, was pillaged, and occupied by the Poles; the great Novgórod was seized by the Swedes; and the whole kingdom was in a state of anarchy and confusion. Nothing seemed to be anticipated but the final partition, or the entire annihilation of the empire, when suddenly and unexpectedly her liberators appeared. Kosma Minin, a butcher of Nijnii-Novgórod, roused by the highest patriotism, resolved to deliver his country from her enemies, or to sacrifice his all in the attempt. He inspired his countrymen with the same sentiments, who immediately contributed their property to bear the general charge, or act for the general good. The old gave their benediction to the young; wives received the oaths of their husbands and children to conquer or die for their country; females, old and young, divested themselves of their ornaments, their pearls, and precious stones; and the citizens transported their most valuable effects to a general depôt. Prince Pojarskii, who had distinguished himself during the reign of the Tsar Shuiskii, was chosen as commander of numerous troops, which were rapidly assembled. He conducted them to Moscow, vanquished the Poles, in various engagements, and liberated Russia from the thraldom of her enemies. A splendid monument has been lately erected at Moscow by the Emperor Alexander, in commemoration of these heroic achievements, on which is the following inscription: "To citizen Minin and Prince Pojarskii, grateful Russia, 1818." Of the events of this disturbed period, a minute account is given by Dr. Lyall, whose work contains a view of the said monument.*

Though there had been divisions among the nobles as to the choice of a sovereign, especially whether they should have a Polish or a Swedish prince, the most powerful party were desirous of elevating to the throne a native Russian, a distant relation of the ancient family of the Tsars, whose father Philaretes, was metropolitan of Rostóf. This young noble at first declined the high destiny, but at length ascended the throne, with almost general consent, and was the first of the present family and dynasty, Románof, whose descendants have raised the empire to a state of grandeur and importance unequalled in any former period.

Assisted by the sage councils of his venerable father, Michail Phoedorovitch, he avoided those disasters which had overwhelmed his immediate predecessors, and acquired the affection and love of his subjects. He formed useful treaties of alliance with the principal commercial states of Europe. His reign of thirty-two years was prosperous for his country and glorious to himself. Under his sway Russia acquired a hitherto unknown importance in the scale of nations. At his death in 1645 or 1646, he was succeeded by one of the most distinguished princes of the present dynasty, the Tsar, Alexei Michailovitch, who was only fifteen years of age. Morosof, a nobleman of consequence, had been appointed his governor and regent of the empire; but by neglecting his duties, he became very unpopular, and, but for the special entreaty of the Tsar, he would have fallen a sacrifice to the rage of the multitude. Alexei increased and strengthened the empire, by introducing a more regular discipline into the army, and by revising, amending, and new-modelling the code of laws, the *Soodébnik*, compiled by Iván Vassilievitch IV., which was now known under the name of *Ullojenié* (or code of laws.) He invited foreign officers into his service, and procured ship-builders from Amsterdam, who were employed in constructing vessels for the Caspian sea, and greatly encouraged commerce. He waged war with the Poles, and with the Swedes, which terminated in peace. He also led his army against the Turks, and left the prosecution of the war to his successor. His merits have been much overlooked, and especially by the adulators of Peter the Great; for it cannot be doubted, by the impartial records of Russian history, that some of the improvements, attributed to Peter, originated with his grandfather, Alexei. When he was removed by death from the throne, he left behind him three sons and six daughters. Two of the sons, Pheodor and Iván, were by a first marriage; the third, Peter, was by a second. Pheodor, the eldest son, who ascended the throne, was a prince of a feeble constitution, and it is generally allowed, also of a weak mind. His administration, however, was useful to his country; and it is supposed that all the beneficial acts of it are to be ascribed to the influence of his sister, Sophia, and the able prime minister, Galitsin. At his death, in the year 1682, he nominated his half-brother, Peter, his successor; but this arrangement was powerfully opposed. His brother, Iván Alexiévitch, a prince who was debilitated by epileptic fits both in body and mind, if he reigned alone at all, it was only for a very short time. Indeed, it can only be said that he nominally reigned, as Peter the Great, and his sister Sophia, were the real administrators of the government. After some disturbances Iván and Peter were crowned joint Emperors of all the Russias, while Sophia was nominated their copartner in the government. In the Museum of Moscow is preserved the double throne in which they usually sat in state, and which contains a secret place behind for Sophia, from which she dictated the minor speeches and answers of the sovereigns.* As the principal events in the life of Peter the Great are already detailed under his life (*vide* Peter the Great), we shall here only give a few short notices of the most important transactions, so as to keep up the connexion of our present history.

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* Character of the Russians, p. 296—305.

From the imbecility of Iván, and the youth of Peter, who was now only ten years of age, the whole power of the government rested in Sophia, and the minister Galitsin. By a revolt of the *Strelsi*, a kind of national militia, this ambitious princess's plans were thwarted, and Peter's party gained much strength. A war with the Turks was resolved on, and Galitsin, led by his vanity, or cajoled on purpose to get rid of him, took the command of the army, for the duties of which he was totally inadequate, as was proved by the result. Two campaigns were passed in marches and counter-marches, and nearly 40,000 men were lost between unsuccessful skirmishes and disease. About the middle of the year 1689, Peter, who had now attained his 17th year, succeeded in securing to himself the undivided sovereignty. Sophia was obliged to retire to the Novo-Devitchei nunnery at Moscow; and his brother Iván, though still nominally Tsar, had voluntarily resigned all participation in the administration of affairs, and withdrawn to a life of obscurity. The first objects to which Peter directed his attention, were the establishment of a regular and well-disciplined army, and the construction of a navy. Lefort, a Genevese, and Gordon, a Scotchman, were of eminent service to him for the organization of the army; and he spared neither trouble nor expence so as to acquire a navy. As has been related in his life, he travelled into foreign countries, and worked like a common carpenter in the dock-yards, that he might become master of ship-building. He prosecuted the war against the Turks with vigour and success, and made himself master of Azof. He formed a plan, with Augustus king of Poland, and Frederick king of Denmark, to deprive the young and inexperienced Charles XII. of his dominions, in which they entirely failed. Indeed, at Narva, with a very small body of troops, Charles obtained a most signal victory over an immense Russian army. After this Peter evacuated all the provinces that he had invaded. Instructed, however, by disasters and skirmishes, in which he was at times victorious, Peter's troops at length defeated the Swedes, which animated them with new courage. Notwithstanding this, they suffered a disgraceful defeat near the Dnéper, when the northern Tsar was glad to make overtures for an accommodation. The advance of Charles XII. to within a hundred leagues of Moscow—his deception by the traitor, Mazéppa, atamán of the Kozáks, who promised more assistance than he could give—the difficulties and hardships his army encountered near the river Disne, in a forest above forty leagues in extent, and filled with rocks, mountains, and marshes—and his signal defeat, after gaining different victories at the battle of Poltava, are well-known events, which have been alluded to under SWEDEN. Charles escaped with great difficulty, and at length reached Otchakof, on the frontiers of Turkey. While Peter was reaping the advantages of his victory, Charles found an invaluable friend in Achmet II. who then filled the throne of the east. In 1711, this sovereign assembled an immense army, and made preparations to invade Russia. The Tsar having had intimation of his design, and expecting to receive great assistance from Kantemir, hospodar of Moldavia, and a vassal of the Porte, resolved to anticipate the Turks, and by rapid marches advanced as far as Yassy, the capital of that province, situated on the Preuth. Here he was surrounded, and but for the prudent and sage counsels of his consort, Catharine I. he would most probably have been taken prisoner, or reduced to the most humiliating terms. But by the treaty which was concluded, Peter was extricated from a dangerous enemy, and returned to his capital. Three years after the death of Charles, in 1718, a peace was concluded 1718.
between Russia and Sweden. The Swedes ceded to Russia, Livonia, Esthonia, and Ingria, or part of Karelia, the territory of Wiburgh, the isle of Oesel, and all the other islands in the Baltic, from Courland to Wiburgh. For these concessions they received back Finland, which had been conquered by Peter, together with 2,000,000 dollars, and obtained some privileges.

After leading one of the most active, extraordinary, 1725.
and useful lives as a sovereign, and repeatedly having known the extremes of good and bad fortune, Peter died in the year 1725. He well merited the cognomen *the Great*, as well as the title of emperor, which he first assumed, and which has been ever since continued to his successors. In his public character, Peter must be allowed to have been a great politician, statesman, and general, although he made some im-

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* Lyall's Character of the Russians, p. 224.

portant blunders in all these capacities. He did not civilize his people, as is generally stated; but he laid, or extended widely, the basis of their civilization. Upon this basis a structure has been gradually rearing, which, it is to be hoped, will continue to prosper through a succession of reigns, until the demi-civilized inhabitants of the north shall be entitled to rank with the other states of Europe. He formed a navy in his empire; re-organized an army; promulgated useful laws; protected, and, to a certain extent, purified the religion of his country; introduced and fostered arts and sciences, and literature; and he ardently and successfully promoted the general improvement of Russia. He founded Petersburgh, and made it his residence, and the capital. He extended the commerce of his empire, and gave every encouragement to trade and manufactures. He made canals, repaired roads, instituted regular posts, and gave regulations for a uniformity of weights and measures. Therefore, as a monarch, he claims our admiration, and with regret we turn to his character as a private individual. His tyranny and cruelty admit of no excuse. The extraordinary sacrifice of his son has been much admired, and we believe still more censured, because his reasons for such an act do not appear sufficiently valid, though sanctioned by a trial, or the form of a trial.

Catharine I. 1725. Peter was succeeded by his consort Catharine I. who had previously shown herself worthy of the imperial throne. During the reign of her spouse, she was distinguished as a woman of a dignified and noble character. After she ascended the throne, she prosecuted, with vigour and prudence, the plans commenced by Peter the Great. Her short reign of two years was characterized by forbearance and mercy. Peter II. 1727. Peter the Great's grandson, Peter II. when only twelve years of age, succeeded Catharine. His reign of three years duration was more distinguished by court intrigue than interesting events. He died of the small-pox, when on the eve of his marriage in 1730. During the latter part of his reign he held his court at Moscow, a measure which gave great satisfaction to the nobles.

Ann. 1730. The male issue of Peter being now extinct, the Duke of Holstein, son to Peter's oldest daughter, by the declaration of the late empress, was entitled to the crown; but the Russians, for political reasons, filled the throne with Ann duchess of Courland, second daughter to Iván, Peter's eldest brother. Her reign was extremely prosperous, and though she accepted the crown under limitations that were thought derogatory to her dignity, yet she broke through them all, and asserted the prerogatives of her ancestors. She was governed by her favourite Biron, whom she raised to the duchy of Courland. She had considerable influence in the affairs of Poland; she narrowly escaped a war with France; she ceded the territories on the shores of the Caspian, which had been seized by Peter the Great, in consideration of some privileges granted to the Russian merchants; she maintained a war against the Turks, and, after one army had been severely beat in the Krimea, she sent new forces, who overcame the Tartars, and desolated that peninsula; she took Otchakof, and subdued Moldavia; and after the loss of above 100,000 men, and vast sums of money, she concluded a treaty with the Porte, by virtue of which Moldavia and Otchakof were given back, and Russia gained nothing, except permission to build a fortress upon the Don.

Ivan Antonovitch. 1740. At the death of Ann in the year 1740, Ivan Antonovitch, the son of her niece, the princess Mecklenburgh, by her will succeeded to the throne. Biron, Duke of Courland, was at first regent; but he being unpopular, it was no difficult matter for that princess, assisted by her husband, to accomplish his banishment to Siberia, and for herself to assume the administratorship.

But Elizabeth, daughter of Peter the Great by Catharine, had a powerful party, by whose assistance she assumed the throne, while the prince and princess of Mecklenburgh were sent into banishment. The young prince Iván was kept in confinement, and afterwards murdered in the castle of Schusselberg. Soon after her accession, Elizabeth nominated as her successor to the throne Charles Peter Ulric, son of the Duke of Holstein Gottorp, by Anne daughter of Peter the Great. This prince was accordingly invited into Russia, became a member of the Greek church, was baptized by the name of Peter Pheodorovitch, and proclaimed grand Duke of Russia, and heir of the empire, in the fortieth year of his age. Soon afterwards he was married to Sophia Augusta Frederica, daughter of Christian Augustus, prince of Anhalt-Zerbst-Donburg, who became the famous princess Catharine II. By the death of Charles XII. emperor of Germany, Maria Theresa, queen of Hungary, was left at the mercy of the enterprising King of Prussia, but was assisted by Elizabeth, who entered into a confederacy, and sent a body of troops into Germany. For an account of a seven years war, the reader may consult the article Prussia.

Elizabeth died on the 5th Jan. 1762, the victim of disease, brought on by intemperance. The empress Ann had given an unworthy example of keeping favourites, which has been followed by all the subsequent princesses who have swayed the sceptre of Russia, and in a more open manner than is sanctioned by the custom of civilized nations. Elizabeth had her portion of them, and her conduct deserves reprobation. She is said to have possessed an extraordinary share of humanity; and, during her reign, punishment by death was unknown, in consequence of a vow she had made, and which led to numerous abuses and enormities in the civil, military, and naval departments. Though she was a woman of no talents, her reign was prosperous; and the same means, as in the time of her immediate predecessors, were continued with the view of improving and civilizing her people. In the year 1758, the Academy of Arts, now one of the most magnificent establishments in the universe, was founded at Petersburgh. Fond of music, she encouraged its cultivation, and she laid the foundation of a Russian theatre. She was also a great patroness of architecture. She followed the same policy as her predecessors, in encouraging foreigners to come and settle in her empire. But the army was much neglected; and a kind of inquisition, under the specious name of a secret state chancery, was instituted, which led to the most flagrant abuses.

The grand Duke Peter III. ascended the throne of Russia on the demise of Elizabeth in 1762. His whole life shows that he was a feeble prince. He attempted many premature and foolish innovations, and by that means disgusted his people. By his inconstancy he lost the affections of his wife, a lovely and accomplished princess in the prime of life. Assisted by the wily princess Dashkof, and by some officers, especially the Orlofs, she formed a party, and, to avoid imprisonment and perhaps death, she succeeded in the dethronement of her husband. On this occasion, but for the greatest pusillanimity, Peter would have regained his crown, and escaped a cruel and barbarous death by poison administered to him while a prisoner at Ropsha, not far from St. Petersburgh. He only enjoyed the imperial dignity three months, and thus ingloriously fell in the 34th year of his age.—Vide *Life of Catharine II.*

After Catharine had ascended the throne, her conduct was cautious and judicious, gentle and magnanimous, even to her declared enemies. From motives of policy she maintained the treaty of peace with Frederic, which had been concluded with Elizabeth. She appears to have had considerable uneasiness at the chance of Iván's being set at liberty. Greater vigilance was employed in guarding him in the castle of Schusselberg; and he was afterwards assassinated, in consequence of the failure of badly concerted measures for his deliverance. Whether his death is to be imputed to the empress and her counsellors is still matter of dispute.

When firmly seated upon the throne, Catharine proved herself worthy of the high destination, and her reign was one of the most brilliant in the annals of time. Her private character seems to have been excellent, excepting the outrage she did to her sex and to morality by openly adopting in succession, a number of declared favourites. The chief events of her life are related in the articles Catharine II., France, Britain, Prussia, and Poland; some others will be noticed under Sweden and Turkey.

Among the most memorable events of Catharine's reign are to be enumerated, the establishment of a new code of laws for her dominions, however badly they were administered; the maintenance of a seven years war with the Turks; the unexpected and extraordinary destruction of the Turkish fleet at Tchesmé by the Russian fleet under the command of Count Alexei Orlof, but chiefly directed by the counsels of our countryman Admiral Greig; the division of the empire into vice-royalties; the visit of the emperor Joseph to Russia; the establishment of public schools throughout her realms; the erection of the justly celebrated monument of Peter the Great; the capture of the Krimea; the receiving under her protection the dominions of Heraclius II. tsar of Kartalinia and Kachetia; the institution of the imperial Russian academy; the repair of roads throughout the empire; the establishment of a loan bank for the accommodation of the nobles and the burghers; her visit to the south of Russia and to the Krimea; the capture of part of the Kubán, and of all the territory between the Boog, the Dnéster, and the Black Sea, from the Turks and their adherents, after a series of victories; the obtaining of various advantages over the Swedes both by sea and land, and then the conclusion of a peace; her participation in the dismemberment of Poland after a successful but cruel war; the conclusion of a treaty of defensive alliance between Russia and Great Britain in 1795; the successful invasion of the Persian territories and her subsequent defeat; and, finally, her sudden disease, which was followed by death.

Catharine the II. died on the 9th of November, 1796, and the grand duke Paul, or rather *Pavel Petróvitch*, was seated on the throne in the fortieth year of his age, totally ignorant of the duties he had to perform, in consequence of having been obliged by his mother's will, to pass much time in obscurity and retirement. His politics and general conduct were very blameable. In consequence of his extraordinary actions, by many he was reckoned a fool and a madman, while others have spoken of him as a misguided man of uncommon penetration, genius, and rectitude, whose grand plans were not allowed to develop themselves, and which were calculated to have rendered him one of the brightest ornaments of his country. The chief political events of his life were his differing with England in 1797; his contrivance to become grand master of the order of St. John of Jerusalem in 1798; the sending of a Russian army under field-marshal Suvárof to join the Austrian army in Italy; and his declaration of war against England.

The progress of Suvárof, his extraordinary success over Moreau, and his recal by his imperial and whimsical master, equally astonished Europe.—Vide Italy, Austria, and Britain.

1801. Paul's conduct became daily more and more singular and tyrannical. The demi-barbarous but brave Suvárof is supposed to have fallen a victim to his caprice, and the atamán of the Kozáks, the celebrated Platoff, had nearly shared a similar fate. Others in power and favour had suffered sudden and great reverses, and no individual could lie down to quiet rest, as he knew not what might be his fate before the dawn of day. The regulations of the emperor with respect to dress and salutations, and the exercise of his police in seeing his errors executed, would fill volumes with ridiculous anecdotes, and have been a great source of amusement for travellers. Dr. Clarke's works are peculiarly rich on these subjects, which are highly absurd and amusing.

Some of the nobles who had suffered private injuries, and who persuaded themselves that they would render a most important service to their country, conspired and effected Paul's death in the most determined and barbarous manner, while in his new palace of St. Michael, and on the 11th March, O. S. 1801.

Alexander. 1801. Early on the following morning, Alexander was proclaimed emperor of all the Russias, and ascended the throne in his 24th year, beloved by all classes of his subjects. Mildness and forbearance were characteristic of the first acts of his government. He arrested the power of the senate, and recalled those who were innocent from banishment. He cultivated the friendship and entered into amicable arrangements with the states of Europe, and he adopted every measure which might procure advantages to his empire. Some of the most remarkable deeds of his commencing reign, were his taking off the embargo which had been laid by Paul on British vessels; his entering into a treaty of commerce with Sweden; his guaranteeing the sovereignty of Malta to the knights of St. John of Jerusalem; his proclamation of the union of Georgia to the empire; his sending two vessels round the world on a voyage of discovery under the command of Captain Krusenstern; and the emancipation of the Jews from the shackles under which they had long groaned, and allowing them various privileges.

1805. After some disputes with France, war was declared, and an alliance formed between Russia and Austria, as also between Russia and Great Britain. The king of Prussia and the king of Sweden soon afterwards entered into an alliance with Alexander. 1806. It was expected that by the united forces of these sovereigns Napoleon would have been hurled from his throne or compelled to listen to equitable terms of pacification. Under the articles Britain, Austria, Italy, Sweden, are particular accounts of the events of this period, but especially under France, where they are detailed with minuteness. The battle of Austerlitz in

1805, in which the combined Austrian and Russian troops were defeated; the battle of Jena, in which the Prussians were signally overcome; the defeat of the Russians at Pultusk; the dreadful contest of Eylau, in which both parties claimed the victory; the surrender of Dantzic to the French; the defeat of the Russians in various engagements, and their complete discomfiture at the battle of Freidland; and the subsequent treaty of peace between Russia and France, which was concluded at Tilsit in 1807, where Napoleon and Alexander had a meeting;—are events which are particularly described under FRANCE. During this war, in the year 1806, an enormous national militia of 612,000 was raised. Under BRITAIN are mentioned the causes that led to a rupture between Russia and that country, and which the latter ascribes to Britain's not having given sufficient assistance against the French, as well as to the seizure of the Danish fleet. An embargo was, in consequence, laid
1808. upon all British vessels. Sweden having refused to comply with the requests of France and Russia, to abandon her alliance with Great Britain, Russia marched an army into Sweden, which, though checked in its progress of hostility, proved but too successful. In 1808 the two emperors, Napoleon and Alexander,
1809. held a second meeting near Erfurt. In 1809 the juncture between Russia and Austria was broken, because this power had carried on war against France. Peace was concluded with Sweden, by which Russia acquired Finland as far as the river Torneo with the
1810. Aland islands. In 1810 a new form was given to the imperial council, and by a manifesto, a part of Gallicia
1811. was taken under protection. In 1811 considerable changes took place with the ministers and the colleges, and the beautiful cathedral of the mother of God of Kazán, which was founded by Paul, and built after the plan of a Russian bondsman, was consecrated. The army of the grand vizier, consisting of 35,000 men, became prisoners to the Russians, who were protecting Imeritia and Bessarabia, and peace was con-
1812. cluded in 1812. Shortly afterwards peace was likewise concluded between Britain and Russia, and then commenced the preparations for the grand struggle of the European powers, one of the most memorable in the annals of time. Under the article FRANCE, is a minute account of the disputes between that country and Russia; of Napoleon's immense preparations for the invasion of Russia in 1812; of his advance to Wilna; of the battles of Witebsk, Smolensk, and Borodino; of the entrance of the French into Moscow, and their operations and miserable situation there; of Buonaparte's retreat and awful disasters; and of the loss of his enormous and fine army. Here we may remark that the *Burning of Moscow*, which the French attributed to the Russians, and which the Russians attributed to the French with the greatest obstinacy for many years, is at length avowed by the Russians. Dr. Lyall endeavoured by a series of arguments to show that the French burned Moscow, and he blames Rostoptchin, who, in a pamphlet, disclaims the honour of being the head of the incendiaries. But Colonel Boutourlin has set the matter at rest, by telling us that Moscow was burnt by the arrangement of *un grand personnage*. Who this great person was, whether Prince Kutuzof, or the emperor Alexander, we are not informed; though we are assured it was not Rostoptchin.

The institution of the Bible Society at Petersburgh, under the immediate protection of the emperor in 1812, is a memorable event. From it branches have spread into the remotest regions even of Siberia, and their number is daily augmenting. Its success has been wonderful, and we trust its effect in humanizing the peasantry will be felt in distant ages.

The history of the campaigns 1812-13-14-15 is given under FRANCE, and therefore we shall not renew the subject here.* We cannot dwell upon the fate of Buonaparte, whose mighty ambition seemed as unchecked as unbounded, whose success appeared as marvellous as his projects were gigantic, and whose fall, as contrasted with his elevation, throws every other example of human vicissitude into the shade. 1812

In consequence of the congress of Vienna, that part of Gallicia acquired by Russia from Austria in 1809, returned to that power, and the greatest part of the principality of Warsaw was then ceded to Russia. Poland, or that part of it over which the emperor of Russia extends his sway, has since been called the *Kingdom of Poland*, and Alexander has added to his other numerous titles, that of *King of Poland*. See POLAND. 1815

At Paris a general treaty of peace was concluded by the associated sovereigns, between Russia, Austria, England, and Prussia, on the one side, and France on the other; in virtue of which the ancient boundaries of France, as in 1790, were again adopted, and 150,000 of the troops of the allies were left in that kingdom for five years in possession of seventeen fortresses, until the return of order and tranquillity. In 1815, the Holy Alliance, as it is called, was formed between the emperors of Russia, Austria, and the king of Prussia, and some other powers afterwards joined it. On the return of Alexander to his capital, the new exchange, a large and handsome edifice, was opened at Petersburgh with great ceremony, by his majesty. In 1816, the emperor visited part of his dominions, and issued an ukàz, henceforth forbidding punishment by tearing out the nostrils. In the winter 1817-18, the imperial court was held at Moscow, and ever since, as before, at Petersburgh.

Our limits do not permit us to enter into the affairs of the different congresses of the sovereigns of the Holy Alliance, at Aix-la-Chapelle, Vienna, Verona, Laybau, &c.; nor to discuss the interference of Russia in the affairs of Italy, Spain, and Portugal. Those with Turkey and Sweden will be particularly related under these titles. In the mean time, it may be mentioned, there is every appearance that the long existing and protracted arrangements for a treaty of peace with Turkey will be speedily brought to a conclusion, chiefly through the interference and influence of the British ambassador at the Porte, Lord Strangford.

Among the chief affairs of Alexander's reign are to be reckoned—the abolition of the secret state chancery, which is now converted into the Bible Society at Moscow—salutary changes and amendments of the laws—the confirmation of the rights of the nobles—the permission given to the nobility to emancipate their peasants, and to grant them leases of land where they might form colonies—the permission to all ranks to acquire immoveable property for themselves—the foundation of different universities, hospitals, and public seminaries—the protection given to arts, sciences, and manufactures of all kinds, which has led to wonderful improvements—the increase of the revenue of the empire—the augmentation and better state of discipline of the army, and the organization of military colonies, of which hereafter—the improvement of the fleets in the Baltic and Black Sea; in a word, the general improvement of his extensive realms, and the elevation of Russia to a rank hitherto unknown among the states of Europe. By means of the marriages of his brothers and sisters with a number of the reigning families, Alexander has also formed close connections which may be useful to the empire.

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* A number of works, besides Labaume's, containing histories of these events, have been published in France, but very lately a most interesting and tolerably impartial work has made its appearance, from the pen of a Russian, entitled "*Histoire Militaire de la Campagne de Russie en* 1812, *par le Colonel Boutourlin, Aide-de-camp de S. M. l'Empereur de Russie.*" And since this article was put to press, the best account of the Expedition to Russia in 1812, has been published by Count de Segur. It is a most entertaining work, and exhibits an excellent picture of Napoleon's mind.

GENERAL AND PROGRESSIVE GEOGRAPHY.

The Russian empire is bounded on the north by the Frozen Ocean; on the west by Sweden, the Gulf of Bothnia, the Baltic Sea, Prussia, Austria, and the Turkish provinces; on the south by the Turkish provinces, the Black Sea, Asiatic Turkey, Persia, the Caspian Sea from the mouth of the Ural, (which falls into the Caspian.) to the mouth of a rivulet which falls on the right side into the Irtish, (about forty versts higher than the river Buchtarma,) by the *steps* of the Kirghis Kozáks, and from hence to the Sea of Ochotsk, by lands under the Chinese dominion, as Zungoria, Mongolia, Manjouria or Dauria, to the east, or more correctly to the south-east, by the Eastern Ocean. Besides this, the Aleutian and the Kurillian islands in the Eastern Ocean, and a part of the north-west coast of America, with the islands to the 55° of north latitude, belong to Russia.—Vide YABLOVSKII and VSEVOLOJSKII.

According to Yablovskii, just quoted, the Russian empire is contained between 35° 20′, and 207° 56′ of north latitude. Its greatest length is between the 55 and 66 parallels, and extends to 1014 geographical miles; but from Cape Laspinskii (in the Krimea) to the northern Tchukotskoi Cape, it measures 1010 geographical miles. The breadth of Russia, in its extent from north to south, is different in different places. In Bessarabia it commences nearly from 45° 15′ of north latitude, and in Lapland it reaches 70°; in the province of Talishin, it begins from nearly 38° 35′, and in the government of Archangel it stretches to 68° 37′ 47″; in the Kirghis Kozák *step* it commences from 54°, and in the government of Tobolsk it goes to 72° 40′; on the Chinese frontier from 49° and 56°, and at the Sea of Ochotsk it begins at 54° 20′, and finishes on the north in the government of Tomsk at 78°; from the Chinese frontier the coast of the Russian empire (excluding the peninsula of Kamtschatka) extends to the north-east, and at 207° 56′ of longitude finishes under 66° 5′ 30″ of latitude, by the north Tchukot Koi Cape. Consequently its greatest breadth is 450½, its least breadth 280, and its middle breadth 368¼ geographical miles. The superficies of the empire, excluding all the large gulfs of the sea, the Sea of Azoph, and the islands lying in the Eastern Ocean, contains 311,066 geographic square miles.

Another Russian author, Vsevolojskii, however, says that Russia contains 330,570 geographic square miles; and by some tables which follow, the Germans extend it to 345,000.

But a few centuries ago, the Russian territory formed a fourth part of the present European Russian, and about a seventeenth part of the present Russian empire. In the reign of Iván Vassilievitch (III.) this territory was augmented 10,000 square miles, and in the reign of Vassilii Ivánovitch 14,000 square miles. Iván Vassilievitch (IV.) tripled the extent of his dominions, and Pheodor (I.) greatly extended them. In the reign of Alexei Michailovitch all the provinces that had been taken by the Poles were reconquered, and besides, he added 257,000 square miles to the Russian states. Under the sway of Pheodor (III.) the dreary region of Nova Zembla was acquired. Peter the Great extended his dominions 280,000 square miles. The empress Ann, treading in the same path of augmentation, left behind her a realm of above 324,000 square miles in extent; and while Catharine the Second held the sceptre of the north, this territory was increased to 335,600 square miles. In the reign of Paul, and since the present sovereign Alexander ascended the throne, the empire has been enlarged to no less than 345,000 geographic square miles; of which 85,000 belong to Europe, and 260,000 to Asia. —Vide Cromé's *Allgemeine Uebersicht der Staatskräfte, &c.* and Lyall's *Pamphlet*, spoken of hereafter.

The empire of Russia at present comprehends the ancient principalities of the great Dukes, together with the kingdoms, countries, and provinces, which have been added at different epochs, (as the natives say by conquests and by restitutions, but as we say, sometimes by fraud and seizure,) as 1st, The kingdom of Kazán; 2d, The kingdom of Astrachán; 3d, Siberia; 4th, The provinces bordering the Baltic; 5th, The provinces *retaken* from Poland; 6th, Courland; 7th, The territory annexed to Russia by the peace concluded with the Turks in 1774, between the Dnéster, the Boog, the Dnéper, and the Black Sea; 8th, The Krimea, and part of the Kaucasus; 9th, The tributary isles in the East Sea; 10th, The countries which have recently submitted themselves, and which form the present kingdom of Georgia; 11th, The possessions in America, partly islands, and partly on the continent of California.—Vide Vsevolojskii's *Dictionnaire*.

FACE OF THE COUNTRY, CLIMATE, AND SEASONS.

Face of the country, climate, and seasons.

By the moderns, the Russian empire is divided by the Ural Mountains and Mount Kaucasus into European and Asiatic Russia. Formerly, several governments west of the Ural Mountains, were reckoned to belong to Asia.* European Russia therefore contains Russia Proper, Russian Lapland, Courland, Livonia, Russian Poland, the Krimea or Tauridain Chersonnesus, and the Land of the Kozáks of the Don and of the Black Sea, and the rest of the Kubán, as far south as the Têrek. Asiatic Russia contains all Siberia, Mount Kaucasus, and Georgia.

Different divisions of the empire have been in use at various epochs, as may be seen by consulting the Tables given hereafter under the head *Population*; and which need not be repeated here, though equally connected with the present subject.

Surface.

In an empire of such enormous extent, as might be expected, its surface presents a great variety of appearances, and especially in Asiatic Russia.

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* As in the Tables hereafter from Hassell and Cromé, under the head *Population*.

Russia.

Mountains. The most celebrated mountains are Mount Kaucasus, stretching between the Caspian and the Black Sea; the Ural mountains, separating Europe from Asia; the mountains of Olonets, which extend to an immense length, and on the north divide Russia from Sweden; the romantic mountains on the south coast of the Krimea; the Altaic chain, which has various names in different places, and separates Russia from China; and the Valdai hills, half way between Petersburgh and Moscow, &c. &c.

Steps or plains. Immense plains called *steps* (by the Germans *steppes*,) some of them barren, others very productive, especially of grass, occupy different parts of both Asiatic and European Russia. In Asia, the principal *steps* are those of the Irtish, of the Oby and Yenissey, of the Yenissey and Lena, and of the Lena and Indighirka. In Europe, are the *steps* of Petshora, of the Dnéper, of the Don, of the Volga, of the Ural, &c. Some of the *steps* in Siberia are covered with forests, or birch, pines and firs, and interspersed with salt lakes.

Soils. The north of Russia contains great tracts of marshy ground, and much of it lies waste; but the south abounds in fertile plains. The most fertile part of European Russia is that between the Don and the Volga. Enormous tracts of Siberia are nearly incapable of agriculture, and the thinness of the population does not call for their improvement.

Morasses. Morasses are frequent in Russia, and are of enormous extent in Siberia.

Seas. The seas connected with Russia are the Arctic ocean, the Eastern ocean or Archipelago, the Inland Seas, the Baltic Sea, the Black Sea, the Sea of Azoph, the Caspian Sea, the Sea of Aral, and the Sea of Ochotsk.

Bays and gulfs. The bays and gulfs of Russia are chiefly the gulf of Finland, the gulf of Archangel, the bays of the Oby and of the Yenissey, the bay of Anadhir in the eastern Archipelago; the harbour of St. Peter and St. Paul, in the southern extremity of Kamstchatka.

Rivers. The Russian empire is watered by numerous and highly important rivers, some of them of small size, and others of great magnitude, and running a course of thousands of miles. Among them are to be enumerated the northern Dvina, (generally though falsely called the Duna,) the western Dvina, the Neva, the Volga, the Oka, the Térek, the Don, the Kubán, the Dnéper, the Dnéster, the Boog, the Ob or Oby, the Irtish, the Tobol, the Yenissey, the Lena, the Yana, the Indighirka, the Kolyma, the Anadhir, the Kamstchatka, &c. &c.

Lakes. Russia is not abundant in lakes considering its size. In Europe, are the Yenadia, in Russian Lapland, the Ladoga, the Onega, and the Peipus, in the neighbourhood of St. Petersburgh, and the Ilmen, and the Belo-Ozéro, in the government of Novgórod. In Asia, the chief lakes are, the Lake or Sea of Baikal, the Lake of Altyn-Noor, or the Golden Lake, and the Lake of Altyn or Telitsko.

Forests. European Russia, for the most part, abounds in wood. Extensive and even boundless forests are seen between Petersburgh and Moscow, Moscow and Vladimir, and in some of the north-eastern governments. Towards the south, woods are less abundant; and the vicinity of the Black Sea, of the Caspian Sea, and the Kubán, are almost naked. In some parts of Siberia are also seen interminable forests; but its northern and eastern parts are destitute of wood.

Islands. In the eastern ocean, are the Aleutian and Kurilian islands. In the Gulf of Finland, Hoglan and some small islands, besides Retusari, the island in which Cronstadt is situated; and at its mouth are the islands of Dogs, Ort, and Oesel. Nova Zembla also belongs to Russia.

Nothing can be more false than the almost general association of extreme cold with the name of Russia; for, in the first place, the summer of its northern governments, though short, is very warm, and even hot; while the inhabitants of the southern provinces enjoy a mild, a warm, or even an Indian climate. In fact, from the immense magnitude of this empire, is to be found the contrast of extremely warm and extremely cold regions. Authors, therefore, with great propriety, in treating of the climate of Russia, have divided the empire into regions, some choosing to form but three, others four regions. Herrmann adopts the following division.

1st, The very cold region, extending from 78° to 60° of north latitude; 2d, The cold region, extending from 60° to 55° of north latitude; 3d, The moderate region, extending from 55° to 50° of north latitude; 4th, The hot region, extending from 60° to the southernmost parts of the empire. In a great extent of the first region there is scarcely any summer, for the few months it does not snow or rain scarcely deserve that name. The eastern districts of this region are much colder and more barren than the western. At Petersburgh, the climate is rude and severe, and sometimes excessively cold. There Fahrenheit's thermometer has stood as low as 39° below 0. When the weather is moderate, the air pure, and the sun shining, and without any wind, a well-clothed healthy person enjoys even this frigid season. But when a severe east wind arises during frost, all animated nature feels its powerful influence. When it snows, with a gentle wind in the depth of winter, nothing can present a more gloomy, lurid, desponding spectacle, than the splendid capital of the north. The spring here, if it deserve the name, has frequently a great deal of frost, snow, and rain, and is peculiarly disagreeable at the breaking up of the ice, when the streets are next to impassable. But "winter gone and summer is:" the transition from one season to the other is almost instantaneous. The short summer of four months is, for the most part, fine, and often delightful. It is occasionally oppressively sultry; so that the cool and beautiful mornings and evenings are highly enjoyed. When the days are at the longest, *i. e.* about 18½ hours, the twilights are charming beyond conception, and sometimes so luminous, that a person can read in the open air at midnight. The autumn has sometimes bright days, but is more generally cloudy, wet, and boisterous. The winter is always severe, but varies considerably both as to the degree of severity, and as to the period of the greatest cold. Most frequently, however, the severest frosts occur in January. During the winter months, the atmosphere is generally dry, and the mortality is less than at other seasons of the year. The length of the shortest day is only five and a half hours; and when they happen to be cold and gloomy, there is little earthly enjoyment out of doors, though the body be well enveloped in a fur shoob, fur cap, and fur boots, so as to defy the effects of cold, and the mind be ever so disposed to gaiety, except the natural amusement of descending the ice-hills, and at trotting matches on the river. But while winter rages without, the inhabitants at home feel not its effects in their well-warmed houses. During this season of the year the Néva is covered with ice nearly a yard in thickness. On an average, there are annually from 160 to 190 days of frost, during which the ground is frozen to the depth of nearly three feet. The aurora borealis is very frequent, and its coruscations peculiarly varied. Thunder storms are not unfrequent, and are sometimes violent, high winds are not predominant, and it seldom hails; but hoar-frosts, producing the most beautiful appearances on the trees, are very frequent. When the sun shines, these trees appear like enormous chandeliers, covered with millions of resplendent gems.

In the second region of the empire the summer is indeed short in many parts; but in most of them it is so warm, and the days are so long, that the fruits of the earth usually come to maturity in a shorter time than in other places. The winter in the greatest part of this region is generally very severe.

In the third region the winter is also long and cold, especially in some parts of Siberia. This is rather owing to the lofty mountains with which these districts abound, than to their high degree of latitude. The governments belonging to this region in European Russia, however, usually enjoy a short and mild winter, and a fine warm summer.

In the fourth region the winter is short, and except in some parts of Irkutsk and Kholivan, not very cold; and the summer is warm, and in many parts very dry. One of the most delightful districts in this region is the Krimea, or rather its south coast.

COMMERCE.

Mr. Herrmann has given various dissertations respecting the commerce of Russia in the *Mémoires de l'Academie Impériale des Sciences de St. Petersburgh,* of whose labours we shall take advantage. In the fifth volume of that work, p. 662, is a paper respecting the interior commerce of Russia in 1813, in which he treats, in succession, of the commerce at St. Petersburgh, Moscow, Riga, upon the river Niemen, of Astrachán, of Taganrog, of the canals of Finland, of the Dnéper and the Dnéster; of the northern provinces, including Archangel, and of Siberia. He enumerates the articles and their value, and concludes with the subsequent tables.

	Roubles.
I. ST. PETERSBURGH. Importation	
by Vishnii Volotchok,	75,099,369
by Tishvin	9,153,694
by Mary's canal	5,381,252
Total	89,634,315
Exportation	
by Vishnii Volotchok	699,672
by Tishvin	8,261,165
by Mary's canal	43,840
Total	9,004,677
Merchandise which had wintered	3,275,430
Grand total of importation and exportation	101,914,422
II. MOSCOW. Importation	34,960,018
Exportation	2,078,972
	37,038,990
III. ASTRACHAN. Importation	12,134,329
Exportation	16,555,947
	28,690,276
IV. SOUTHERN PROVINCES.	
Navigation upon the Dnéper	9,760,635
Dnéster	383,887
	10,144,522
V. NORTHERN PROVINCES.	
Upon the Dvina	9,046,099
Upon Catharine's canal	286,672
	9,332,771
VI. RIGA, upon the Dvina,	7,469,236
upon the Beresina	640,441
	8,109,677
VII. TAGANROG, upon the Don,	4,327,084
VIII. Navigation upon the Niemen	6,675,046
upon the canal of Ojinskii	421,892
	2,096,938
IX. Upon the canals of FINLAND	169,407
X. Commerce of SIBERIA.	
Upon the Irtish	1,787,336
Tura	507,407
Tobol	11,630,236
	13,924,979

Russia.
Commerce.

As the importation is not always separated from the exportation, we cannot value these two *titres* except by approximation.

	Importation.	Exportation.
For St. Petersburgh	Ro. 89,634,315	Ro. 9,004,677
Moscow	34,960,018	2,078,972
Astrachan	12,134,329	16,555,947
Archangel	9,332,771	
Riga	8,109,677	
Taganrog	4,327,084	
Upon the Niemen		2,096,938

For the commerce of the southern provinces, that of the canals of Finland, and upon the rivers of Siberia, both of importation and exportation, our data only present the total.

But nevertheless, we see by these data that the known importation surpasses the exportation by about $5\frac{1}{3}$. The first amounts to 158,498,194 roubles, the second to 29,736,534 roubles.

Astrachán has the most considerable exportation; St. Petersburgh the greatest importation of the interior.

As the prices of merchandise and the value of money vary, Herrmann has given a general table of all the merchandise which passed in 1813 by the principal rivers and canals of Russia, in another and subsequent paper in the same volume of the *Mémoires.* In vol. vi. p. 686, the same author gives a statistical account of the principal fairs of Russia, viz. of Makariéf (now of Nishnii Novgórod) and of Irbit, and also of that of Romen in the government of Poltava, and of Korennaya Pustinya in that of Kursk. In vol. vi. p. 810, are contained most valuable statistical tables respecting the foreign commerce of the Russian empire, from the year 1802 to 1807, and from 1812 to 1815, which were presented by Herrmann on the 24th Sept. 1817, to a conference of the Imperial Academy. The statistical accounts of the years 1808-11 are awanting, and this deficiency renders the difference between the two tables still more striking. One of them includes part of the time of the continental system, and the other that of Europe delivered.

The total commerce of Russia, by sea and land, during these ten years, was as follows:

Years.	Importation.	Exportation.	Years.	Importation.	Exportation.
	Roubles.			Roubles.	
1802	56,530,094	63,277,759	1812	79,365,560	139,255,713
1803	55,557,855	67,148,643	1813	121,084,865	133,807,040
1804	49,500,109	59,017,549	1814	113,785,322	196,216,820
1805	55,529,118	72,430,185	1815	114,729,440	220,895,110
1806	51,641,466	62,649,556	Total	426,965,187	690,174,683
1807	40,403,662	53,564,901	Medium	106,741,296	172,543.670
Total	309,162,304	378,088,593			
Medium	51,527,051	63,014,766			

In comparing the mediums, it results that the importation has more than doubled of late years; for there is a surplus of 55 millions of roubles; and that the exportation has nearly tripled, for it exceeds by 109 millions that of the years indicated in the first table.

In general, the exportation has been greater than the importation. According to the first table, there had been exported for 12 millions; according to the second table, for 66 millions above that of the importation. But even in supposing that there had been considerable smuggling, the surplus of exportation would still be in favour of Russia.

The year the least favourable for commerce was 1807; the most extensive was 1815. The total foreign commerce in the first year was 93 millions, and that of the last 334; therefore there was an excess of 241, which gives the proportions of 1 to 3½.

All the *Revirement* of commerce amounted in the first period per annum at a medium to 114,541,817 roubles, and in the second to 279,284,966 roubles, and therefore surpassed that of the first period by 164,743,149; *i. e.* that it had more than doubled, without including the commerce by transit, of which we shall speak hereafter.

The grand channels of this commerce by sea and land, the principal kinds of merchandise imported and exported, and the commerce of St. Petersburgh in particular, merit general attention.

I. *Commerce by Sea.*

Years.	By the Baltic.*		By the White Sea.†		By the Black Sea and the Sea of Azof.‡		By the Caspian Sea.§	
	Importation.	Exportation.	Importation.	Exportation.	Importation.	Exportation.	Importation.	Exportation.
1802	32,983,418	46,917,134	549,732	4,796,017	2,054,789	2,986,096	666,044	89,984
1803	30,125,676	49,430,718	504,506	4,802,638	2,960,886	4,924,050	802,192	150,138
1804	27,107,653	45,152,020	388,669	2,221,490	4,216,343	4,915,357	757,241	96,485
1805	28,930,001	52,115,188	389,872	3,754,091	5,365,059	7,403,372	857,201	126,564
1806	27,191,468	49,143,759	287,226	4,095,661	4,730,138	3,628,323	544,760	91,443
1807	27,394,978	43,027,294	587,424	3,287,034	584,977	397,694	1,077,610	185,599
Total	173,733,194	285,786,113	2,707,429	22 956,931	19,956,931	14,254,892	4,705,048	740,213

From this Table, it results, 1st, That the importation upon the Baltic Sea, and upon the White Sea, during the above period, was very inferior to the exportation; that commerce was more equal upon the Black Sea, but that the importation greatly surpassed the exportation upon the Caspian Sea.

2d, That the importation upon the Baltic Sea has diminished, but that the exportation has been better sustained. The first phenomenon was the effect of the continental system; the second arose from the want which foreigners had of Russian productions.

3d, That the commerce of the White Sea is chiefly commerce of exportation, which has been pretty well sustained in spite of all obstacles.

4th, That the commerce upon the Black Sea is the most equal commerce among the commercial nations. The surplus which there is of that of exportation, arises chiefly from the commerce of Odéssa in corn.

5th, That the commerce upon the Caspian Sea is the most disadvantageous to Russia, the importation being seven or eight times greater than the exportation.

6th, That the general importation by sea amounted, during this period, at a medium to 33,506,643 roubles, and the exportation to 55,623,024. The balance was therefore in favour of Russia; for there was 22,116,381 roubles more exported than imported.‖ Assuredly we ought to allow something for smuggling, but still the balance was favourable for Russia.

7th, That the general trade amounted to 89,129,667 at a medium per annum.

The second table upon the commerce by sea contains the following data:

Years.	By the Baltic Sea.		By the White Sea.		By the Black Sea and the Sea of Azof.		By the Caspian Sea.	
	Importation.	Exportation.	Importation.	Exportation.	Importation.	Exportation.	Importation.	Exportation.
1812	47,542,819	82,933,106	8,713,083	10,609,158	3,019,905	10,767,677	1,059,138	309,689
1813	69,937,446	76,474,118	5,549,598	7,723,398	6,364,631	15,480,616	2,337,734	1,918,824
1814	80,072,063	129,517,007	1,140,864	8,845,528	9,600,063	15,396,537	2,962,388	1,769,625
1815	80,135,941	141,682,571	2,499,332	15,854,110	7,714,974	22,020,421	2,203,644	2,032,182
Total	297,688,269	430,606,802	17.902,877	43,032,191	26,699,573	63,665,251	8,562,904	6,030,320

The same phenomenon takes place in this period of a flourishing commerce; the exportation is every where much superior to the importation, except upon the Caspian Sea.

The importation by the Baltic sea, in 1813, is unique in its kind; it exceeds by forty-two millions that of the year 1812; it even exceeds the exportation by thirteen millions. When the continental system fell to the ground, and when peace was restored to Europe after the dreadful conflict of 1812, England especially filled the ports of Russia with colonial merchandise and her manufactured goods, in as far as the then existing Tarif permitted. Neither France nor Spain could as yet take an active part in this enormous importation into Russia, the Hanseatic towns were in part ruined; it was from England then especially that this enormous mass of merchandise was imported. This period passed, the importation by the Baltic Sea fell somewhat, but it always remained thirty-three millions superior to the year 1812, and fifty-three millions superior to the last years of the preceding period. By the White Sea the importation during the last period, from half a million and less, suddenly rose to above eight millions. This was an extraordinary case, which is accounted for by the military affairs of that year. When Russia became more tranquil, the great importation retook its ordinary course by St. Petersburgh; it necessarily diminished at Archangel, but it still remained by two-thirds superior to that which it had been in the preceding period. By the Black Sea, and by the Sea of Azof commerce augmented, but not so rapidly as by the Baltic Sea, because this commerce had always experienced *moins d'entranes*, during the period of the continental system. Lastly, the commerce by the Caspian sea has preserved its character, i. e. that the importation exceeds the exportation, at the same time there is an infinitely greater equality than formerly; when during six years there was imported for four and a half millions, and only exported for 700 000 roubles, for in these last years there has been imported for eight and half millions, but there has also been exported for six millions; an exportation unheard of by this channel, and which appears to augment annually.

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* At St. Petersburgh, Cronstadt, Riga, Pernau, Narva, Arensburg, Wiburg, Libau, Fridericksham, Windau, Reval, Hapsal.

† At Archangel and Onega.

‡ At Odessa, Nickolaëf, Ovidiopol, Eupatoria, Sevástopole, Kertch, Theodosia, Taganrog, Mariopòle, Yenikalé.

§ At Astrachan.—*N. B.* All the calculations in this and the following Tables of course are in roubles.

‖ The original is, " Plus d'importé qu'exporté," which we suppose to be a mistake.

Russia. Commerce.

The exportation by all channels presents the most satisfactory results. It surpasses (in only reckoning by millions) the importation

By the Baltic Sea, by	133 millions.
By the White Sea, by	26
By the Black Sea, and by the Sea of Azof, by	37
Total,	196

that foreign countries have paid to Russia during four years of victory, not by the kind of extraordinary receipt of the time of the French Revolution, but by a free and regular commerce. It surpasses the exportation in the time of the continental system by one hundred and forty-five millions by the Baltic Sea, by twenty-one millions by the White Sea, and by thirty-nine millions by the Black Sea and the Sea of Azof: total two hundred and five millions more exported in four years than before in seven years of a languishing commerce. We have already noticed how much the exportation by the Caspian Sea has gained, viz: 5,390,107 roubles.

The total importation by sea, during these four years, amounts to 350,853,623 roubles, or at a medium per annum, to 87,723,405 roubles:—54,216,762 more than during the first period; it has therefore more than doubled.

The total exportation was 543,844,567 roubles, per annum 135,836,141, or 80,213,177 roubles more than during the preceding six years.

The general *Revirement* has been upon an average 223,559,546 roubles; it has therefore been 134,429,879 roubles greater than during the period that the iron hand of despotism held Europe enchained.

II. *Commerce by Land.*

	With Sweden.		With Russia, Germany, and Austria.		With Moldavia, Wallachia, and Bessarabia.	
	By the Governments of Finland and Olonets, viz. by Sardopole, Nishlot, Willmanstrandt, and Joushkozer.		By the Governments of Wilna, Grodno, by Volchinia and Podolia, Polangen, Jonburg, Kovno, Grodno, Brett, Radzivilof.		By the Governments of Podolia, Kherson, Mohilof, and by Parkanak and Dubosiar.	
Year.	Importation.	Exportation.	Importation.	Exportation.	Importation.	Exportation.
1802	99,068	110,391	11,572,345	4,487,996	2,471,867	779,064
1803	53,656	68,423	11,018,314	4,784,639	3,087,655	473,056
1804	64,016	43,606	8,459,563	3,426,157	2,268,863	415,838
1805	83,881	57,302	8,122,163	4,924,251	2,687,708	481,119
1806	82,249	62,421	10,260,180	2,584,227	1,616,202	434,176
1807	72,196	58,295	3,186,052	2,756,710	779,222	449,423
Total	455,066	400,438	51,618,617	22,963,979	12,911,517	3,032,676

	With Persia and the Mountain Tribes.		With Chiva, Bucharia, and the Khirgis.		With China.	
	By the Governments of Astrachan and the Kaucasus, Kislar, Proteshnoi-Okopsk, Ustlabinsk, and Mosdok.		By the Governments of Orenburgh, Tomsk, and Tobolsk; Orenburgh, Omsk, Troitsk, Petropavlovsk, Semipalatinsk, Kaminegorsk and Buchtrma.		By the Governments of Irkutsk, Kiacht, and Zurutchantovesk.	
Year.	Importation.	Exportation.	Importation.	Exportation.	Importation.	Exportation.
1802	201,268	15.348	2,440,256	1,079,410	4,491,307	2,016,320
1803	192,177	16,881	2,993,664	793,298	3,819,129	1,704,802
1804	138,982	6,826	0,345,144	784,020	4,753,635	1,955,750
1805	180,483	9,934	3,169,936	1,180,980	5,742,814	2,377,884
1806	281,542	15,506	2,671,009	1,104,127	3,976,692	1,489,913
1807	184,021	4,615	1,099,156	881,772	5,438,026	2,513,465
Total	1,178,472	72,110	13,719,165	5,823,607	28,221,603	10,957,634

The principal commerce of Russia by land is that with Prussia, Germany, and Austria, from Polangen to Radzivilof, and with China by Kiachta; the commerce of the second rank is with China and Bucharia, Moldavia, Wallachia, and Bessarabia; the most inconsiderable commerce is that with Persia and Sweden.

By these different channels of commerce Russia lost enormously during this sad period, for the medium of known importation amounted to 18,017,408 roubles, while the medium of exportation was only 7,391,741 roubles. And as the frontiers by land are much more difficult to guard against smuggling than the sea-ports, especially of so enormous an extent as from Finland to China, it may be reckoned certain that the importation surpassed the exportation at least by two-thirds.

The greatest variations of commerce are found in the importation in the commerce with Russia, Germany, and Austria, for, from ten to eleven millions, it suddenly fell to three millions. Political circumstances were the cause of this. The commerce with China, although always unfavourable, has been better sustained.

But we shall now take a glance at the second table, so as to compare it with the first, to draw final conclusions. It is arranged in a different manner from the first, and contains fewer details.

	By the Frontiers of Europe, from Polangen to Dubossar.		With Persia.		By the Asiatic Frontiers, from the Caspian to China.		With China.	
Year.	Importation.	Exportation.	Importation.	Exportation.	Importation.	Exportation.	Importation.	Exportation.
1812	8,014,229	28,928,981	1,002,728	71,753	4,829,537	3,291,486	2,936,167	1,397,676
1813	7,485,145	23,471,019	1,390,114	104,315	2,979,221	3,016,909	5,464,673	4,238,477
1814	9,229,887	31,350,484	1,185,864	100,524	5,229,377	3,808,269	3,934,077	3,268,654
1815	7,683,089	27,749,124	864,888	93,927	6,966,326	4,214,860	5,802,258	5,002,116
Total.	32,412,350	111,499,608	4,443,594	370,522	20,004,441	14,331,524	18,137,175	14,906,923

The total of importation amounted to 71,997,580 roubles, the exportation to 141,108,577 roubles; therefore there was a surplus of 69,110,997 roubles, a phenomenon which had not been seen for a long time; but such, says Herrmann, are the happy effects of valour and liberty.

The importation then was, at a medium, 17,999,395 roubles per annum, the exportation at 35,252,244, *i. e.* double. The importation has remained almost the same as in the first period, but it is the exportation which has augmented in an astonishing manner. It has not augmented by all the channels of commerce by land, it is only by the channel of the frontiers of Europe that this enormous surplus is found, every where else the importation surpasses the exportation; however, the exportation by the Asiatic frontiers, and by Kiachta has greatly gained; whence it follows, that in this respect, the two tables have the same character, viz. Russia even at present loses by her commerce by the Asiatic frontiers, and with Persia and China; but she gains by that of the frontiers of Europe.

In comparing the commerce of Russia by sea and by land we find the following data.

	Medium per annum, from 1802—1807.		Medium per annum, from 1812—1815.	
	Importation.	Exportation.	Importation.	Exportation.
By Sea	33,506,643	55,623,024	87,713,405	135,836,141
By Land	18,017,408	7,391,741	17,999,395	35,252,244

Exportation has always been favourable to Russia in her commerce by sea; it was not so in the preceding period for her commerce by land. In the first period, the commerce by land was to that by sea as one to three and about three-fourths, in the second period as one to four and something more.

The commerce by sea is not only the most considerable of Russia, but it is likewise the most lucrative; at all times it has gained more or less. The commerce by land is only favourable to Russia by the channels on the European frontiers; but in the actual state of things in truth, every other commerce by land is indispensable, but always more or less unfavourable.

The principal articles of the commerce are about twenty-four of exportation. Among these, lint and hemp, with other seeds and oil, corn, hog's lard, and wood, are the principal. Iron, linen, leather, potashes, tar, wax, soap, cords and cables, and furs, are the most considerable objects, as the produce of manufactures and fabrics.

There are above thirty-two articles of importation, among which are *les provisions de bouche*, especially sugar, coffee, and wine. Herrmann has given some excellent tables respecting the kind of goods imported and exported, which we cannot copy here, but which are worthy of attention. He also gives a table of the commerce by Transit, which is interesting.

We shall conclude this part of our subject with a valuable table of the commerce of St. Petersburgh, as it is the chief entrepôt of the foreign commerce of Russia; and, as upon an average, above one-third of that commerce is carried on in it.

Years.	Importation.	Exportation.	Years.	Importation.	Exportation.
1802	24,735,483	30,456,802	1812	39,210,883	58,906,35
1803	22,823,617	31,703,765	1813	75,799,838	53,634,495
1804	21,065,007	29,269,244	1814	64,440,375	91,795,34
1805	20,489,067	29,831,416	1815	65,673,193	107,355,47
1806	18,776,193	28,739,540	Total.	245,024,289	311,691,644
1807	18,202,536	28,631,826	Medium.	61,256,072	77,922,961
Total.	126,091,903	178,632,593			
Medium.	21,051,317	29,772,099			

It results that the importation of St. Petersburgh has almost tripled in the last period, and that the exportation has more than doubled, *i. e.* that it stands about one to two two-thirds. For some years after 1815, commerce between Russia and Great Britain was very inactive, because the market had been previously overstocked by immense importations; and of course as the imported merchandise remained on hand, the means of exchange were not possessed by the merchant. The prices of British merchandise also sunk extremely low. Within the two or three last years, however, trade has considerably revived, though by no means so extensive as is desired.

The commerce of the Black Sea, especially of Odéssa, it is to be hoped, will now be greatly increased. The uncertainty of a rupture between Russia and Turkey, and the agitation of the question, whether Odéssa should remain a free port or not, have done incalculable mischief to the commerce of that town; but as these points seem to be nearly settled, a great and favourable change may perhaps be anticipated.

POPULATION.

In the early periods of Russian history, the population of the territories of the great Dukes and Tsars must have advanced very slowly, owing to the devastations caused by domestic feuds, foreign invasions, wars, want of cultivation, and consequent scarcity of provisions. Its increase must also have been retarded among a people dwelling amid unlimited forests, and boundless deserts, from want of a regular and permanent government, from the oppression of imposts, or rather of the commissioners, from frequent fires, from furious attacks of wolves, and other wild animals, and from the ignorance and indolence of the inhabitants. It would lead us into too minute details to enter upon the various conjectural data respecting the population of the empire in early periods, as nothing accurate is known previous to the year 1722, when the first census was taken by order of Peter the Great. Of late years much attention has been given to the population of the Russian empire, and we shall endeavour here to compress the most valuable part of it under a succinct view.

The following account is taken from the appendix of Lyall's pamphlet on the military colonies.

TABLE *showing the Progressive Increase of the Population of the Russian Empire, by Births, by Conquests, and by the Introduction of Foreign Colonies.*

Census.	Year.	Number of Souls.
1	1722	14,000,000
2	1742	16,000,000
3	1762	20,000,000
4	1782	28,000,000
5	1795	36,000,000
—	1807	35,000,000
6	1811	37,000,000
—	1818	45,542,000 48,000,000
7	1824	53,778,000

Where there is no number under *census*, the statement is taken from the works referred to below; and indeed from them this table is composed. *Geographical Dictionary of the Russian Empire;* Yablovskii's *New Russian Geography;* Vsevolojskii's *Dictionnaire Géographique-Historique de la Russie;* Cromé's *Allgemeine Uebersicht der Staatskräfte*, 1818; Dupin *in the Revue Encyclopédique*, &c.; *and* Herrmann's *Works*, spoken of in the sequel.

The following statement of the population of Russia occurs in the *St. Petersburgh Journal.*

Year.	Population.
1800	33,159,960
1801	34,043,357
1802	34,893,898
1803	35,134,177
1804	36,043,483
1806	41,253,483

The births to the deaths in some provinces are as 13 to 10; 20 to 10; and 30 to 10. Consequently, in the year, of 30,000,000 souls, only a few more than 600,000 die, while above 1,000,000 are born. From the year 1722 to 1792, *i. e.* in 70 years, (*Geographical Dictionary of the Russian Empire*, vol. v. p. 167.) Russia increased her population from 14 to 35 millions. It has been calculated that she doubles her population in somewhat less than half a century. (Tooke's *View of the Russian Empire;*) and Mr. Stchekatof, the author of the celebrated *Russian Dictionary*, just referred to, calculating that she is still destined to continue her march in augmenting her population by births and by the conquest of new territories, prophesies that, in 1892, the population of Russia will amount to 230,000,000 souls.

We shall next present the reader with some tabular views by Hassell, Cromé, and Herrmann. The subsequent table is translated from Hassell.

		Square miles.	Inhabitants.
A	IN EUROPE,	72,640	34,394,400
a)	Great Russia,	40,575	13,324,900
	Governments.		
1.	Moscow,	475	1,126,000
2.	Archangel, with Nova Zembla,	16,226	141,500
3.	Vologda,	6,876	590,000
4.	Olonets,	3,787	281,400
5.	Kostrom,	1,809	1,147,000
6.	Novgórod,	2,578	825,300
7.	Pskof,	1,045	636,300
8.	Smolensk,	1,009	965,000
9.	Tver,	1,135	969,800
10.	Nijni-Novgórod,	961	992,300
11.	Vladimir,	921	960,700
12.	Tula,	559	904,100
13.	Kaluga,	395	845,400
14.	Yaroslaf,	672	800,400
15.	Kursk,	702	1182,500
16.	Voroneje,	1,434	957,000
b)	Little Russia,	7,040	9,055,900
17.	Orel,	850	1,001,500
18.	Riasan,	781	941,400
19.	Tambof,	1,271	1,023,100
20.	Slobodes of the Ukraine,	1,118	657,900
21.	Tchernigof,	1,190	1,014,700
22.	Poltava,	851	1,350,800
23.	Kief,	979	1,066,500
c)	Black and White Russia	4,774	4,711,700
24.	Mohilof,	919	813,000
25.	Vitebsk,	668	672,600
26.	Minsk,	1,098	968,400
27.	Volchinia,	1,394	1,076,500
28.	Podolia,	695	1,181,200
d)	Lithuania,	1,824	1,753,700
29.	Wilna,	1,082	962,100
30.	Grodno,	536	608,300
—	Bielostok,	206	183,300
e)	New Russia,	8,096	1,801,600
31.	Yekaterinoslaf,	1,417	541,300
32.	Kherson,	1,207	407,000
33.	Tawida, or Crimea	1,646	301,400
—	Land of the Don Kozáks,	2,976	318,900
—	Bessarabia, with Moldavia,	850	233,000
f)	The kingdom of Poland,	2,215	2,793,000
g)	The East-Sea Provinces,	8,116	2,953,300
34.	St. Petersburgh,	849	655,700
35.	Finland,	5,332	1,082,400
36.	Esthonia,	487	217,760
37.	Livonia,	939	579,300
38.	Courland,	509	418,200
B	IN ASIA,*	272,590	8,376,000
a)	Kingdom of Kazán,	11,402	4,339,100
	Kazán,	1,045	834,700
	Pensa,	778	700,500
	Simbirsk,	1,402	827,500

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* It will be remarked, that the old division of Asia and Europe is followed both in this and also in a table from Cromé; a circumstance which accounts for their great variation from modern authors.

Russia.
Population.

		Square miles.	Inhabitants.
	Viatka,	2,222	930,800
	Perm,	5,955	1,045,600
b)	Kingdom of Astrachán,	48,714	2,799,900
	Astrachan,	3,142	362,000
	Kaucasus,	2,600	100,500
	Sarátof,	4,293	897,900
	Orenburg,	9,626	639,500
	Georgia,	872	300,000
	Imeritia, with Dághistan	500	200,000
	Step of the Kirghis,	31,681	300,000
c)	Kingdom of Siberia,	212,474	1,237,000
	Tomsk,	68,573	352,000
	Tobolsk,	16,813	447,000
	Irkutsk,	126,460	430,000
	Behring's islands, Copper islands,	134	8,000
	Kurilian islands,	146	
	Aleutian islands,	348	
C	In America,	——	800

The population of 1816, according to the following data, amounted to 45,515,797, as given by the same author.

Revision of 1793-6,	35,166,369
Eighteen years surplus,	4,202,728
Georgia, with Derbent,	210,000
Step of the Khirjhir,	300,000
Bielostok,	183,000
Savages unnumbered,	1,000,000
Unnumbered tribes,	340,800
Russian America,	800
Finland,	895,800
Bessarabia, with Moldavia,	233,000
Poland,	2,793,000
Imeritia, with Dághistan,	200,000
Total,	45,515,797

Hassel says these inhabit 1800 towns, and 170,000 suburbs and villages. The nobles may be reckoned about 580,000; the clergy 400,000; the merchants 300,000; the burghers 1,000,000; those free of taxes 2,500,000; the Kozáks, the Circassians, &c. 2,200,000; the peasants 1,796,600; the Jews 510,000; those appertaining to the crown 120,000; the army and the navy 1,000,000; savage nations 1,000,000 souls of both sexes.

We shall next present two tables which occur in Dr. Lyall's pamphlet, and which he chiefly translated from Cromé.

STATISTICAL TABLE OF RUSSIA IN EUROPE.

Names of the Provinces.	Geographical Square Miles.	Number of Inhabitants.	Souls for each Square Mile.
a. *Baltic Provinces.*			
1. Government of St. Petersburgh	849	655,700	772
2. Finland .	5,332	1,082,400	203
3. Esthonia .	487	217,700	447
4. Livonia .	939	579,300	617
5. Courland .	509	418,200	822
b. *Great Russia.*			
6. Government of Moscow .	475	1,126,000	2,360
7. —— of Archangel, with Nova Zembla	16,226	141,500	9
8. —— Vologda	6,867	590,000	86
9. ——Olonets .	3,787	281,400	74
10. —— Kostrom .	1,809	1,147,000	634
11. —— Novgórod	2,578	825,300	321
12. —— Pskof, or Pleskof . .	1,045	636,300	608
13. Smolensk .	1,009	965,000	956
14. —— Tver .	1,135	969,800	855
15. —— Nijni-Novgórod .	961	992,300	1,033
16. —— Vladimir .	921	960,700	1,043
17. —— Tula .	559	904,100	1,617
18. —— Kaluga .	395	845,400	2,140
19. —— Yaroslaf .	672	800,400	1,191
20. —— Kursk .	702	1,182,500	1,684
21. —— Voroneje	1,434	957,000	695
c. *Little Russia.*			
22. —— Orel .	850	1,001,500	1,178
23. —— Riasan .	781	941,400	1,205
24. —— Tambof .	1,271	1,023,100	805
25. —— Slobodes of the Ukraine, or Kharkof .	1,118	657,900	59
26. —— Tchernigof	1,190	1,014,700	853
27. Poltava .	851	1,350,800	1,584
28. —— Kiéf .	979	1,066,500	1,089

STATISTICAL TABLE OF THE RUSSIAN EMPIRE.

Names of the Nations.	Number.	Religion.	Number.
I. Sclavonian Race.			
a. Russians and Kozáks	30,000,000	a. Greek. Russians, Kozáks, and Wallachians, together with many Greek Christians in Asiatic Russia and in Siberia .	34,000,0
b. Poles, Lithuanians, Courlanders, Raitsens, or Servians	8,200,000		
II. Fins, in 13 Tribes, as		b. Catholic.	
1. Proper Fins	3,000,000	Poles, Lithuanians, Germans, French	6,800,00
2. Laplanders			
3. Livonians			
4. Esthonians		c. Lutheran	1,400,0
5. Tcheremiss			
6. Vogouls		d. Reformed church	28,0
7. Votiaks			
8. Tchuvashes		e. Herrenhutters	9,000
9. Mordvas, or Morduans		f. Menonites	5,00
10. Permians			
11. *Zirianes*		g. Armenians	48,000
12. Teptiars			
13. Ostiaks of the Ob		h. Jews. .	500,0
III. Tartars .	1,750,000	i. Mahomedans	1,850,0
IV. Kaucasians Georgians Circassians	400,000	k. Lamutes .	300,000
		l. Brahmins Hindoos	300
V. Mongols Kalmuks .	300,000	Fetish (Idolaters) Worshippers of Fire, and Shamans or Sorcerers	600,000
VI. Manshures, Tunguses, Lamutes	80,000		
VII. Samoyedes (Polar People) .	12,000		

Table Continued.

STATISTICAL TABLE OF RUSSIA IN EUROPE.

Names of the Provinces.	Geographical Square Miles.	Number of Inhabitants.	Souls for each Square Mile.
d. *Black and White Russia.*			
29. Government of Mohilof	919	813,000	884
30. —— Vitebsk .	668	672,600	1,007
31. —— Minsk .	1,098	968,400	882
32. —— Volchinia .	1,394	1,076,500	772
33. —— Podolia .	695	1,181,200	1,700
e. *Lithuania.*			
34. —— Wilna .	1,082	962,100	889
35. —— Grodno .	536	608,300	1,135
— Bielostok .	206	183,300	890
f. *New Russia.*			
36. Yekaterinoslaf	1,417	541,300	382
37. Kherson .	1,207	407,000	329
38. Taurida, or Krimea	1,646	301,500	183
— Land of the Don Kozáks .	2,976	318,900	107
— Bessarabia with Moldavia .	850	249,000	274
g. *Kingdom.*			
Poland . .	2,215	2,893,000	1,306
Total	72,640	34,500,000	475

STATISTICAL TABLE OF THE RUSSIAN EMPIRE.

Names of the Nations.	Number.	Religion.	Number.
VIII. Nomad Tribes in the north and in the east of Siberia .	1,000,000		
IX. Foreigners and Colonists from many European countries	300,000		
X. Turks and Armenians in Moldavia and Bessarabia	500,000		
	45,542,000		45,540,000

We have been at great pains in arranging the contents of the following table, chiefly from the Russian work of Yablovskii, already quoted, and which we believe to be pretty accurate, and to be very comprehensive and important.

Russia at present is divided into forty-nine governments,[*] thirteen provinces and islands, &c. Of the forty-nine governments in Russia, forty-five are now reckoned to belong to Europe, and four to Asia. Of the Russian provinces some are in Europe, and others in Asia. All the islands lie in the Baltic Sea, and in the Eastern Ocean. Of the forty-nine Russian *governments*, thirty-six are administered according to general laws, and thirteen according to particular laws. The *provinces* of Russia are governed each according to its particular laws.

Governments administered according to General Laws.

No.	Name.	Population.
1.	Government of Archangel, .	210,000
2.	Vologda, . .	702,900
3.	Olonets, . .	245,238
4.	St. Petersburgh,	600,000
5.	Pskof, or Pleskof,	782,000
6.	Novgórod, .	765,773
7.	Tver, . .	1,200,825
8.	Smolensk, . .	1,190,000
9.	Moscow, . .	946,784
10.	Vladimir, . .	1,200,000
11.	Yaroslaf, .	992,994
12.	Kostrom, .	1,013,640
13.	Viatka, . .	1,120,190
14.	Perm, . .	1,113,238
15.	Orenburg, .	787,648
16.	Simbirsk, . .	1,200,000
17.	Kazán, .	1,049,090
18.	Nijni-Novgórod, or Nije-Górod, .	1,042,930
19.	Pensa, . .	862,455
20.	Tambof, . .	1,266,700
21.	Riasan, . .	1,087,790
22.	Tula, . .	1,115,000
23.	Kaluga, . .	986,946
24.	Orel, . .	1,228,200
25.	Kursk, . .	1,424,000
26.	Kharkof, or Slabodes of the Ukraine, . .	1,030,000
27.	Voroneje, .	1,180,000
28.	Sarátof, . .	883,600
29.	Astrachán, . .	76,000
30.	Kaucasus, . .	122,400
31.	Yekaterinoslaf, .	666,163
32.	Kherson, . .	370,430
33.	Krimea, or Taurida, . .	254,931
34.	Tobolsk, . .	550,000
35.	Tomsk, . .	434,000
36.	Irkutsk . .	500,864
	Land of the Tchuktchi.	

Governments administered according to Particular Laws.

No.	Name.	Population.
37.	Government of Esthonia, . .	263,300
38.	Livonia, . .	715,400
39.	Courland, . .	510,000
40.	Vitebsk, .	828,800
41.	Mohilof, . .	1,000,000
42.	Minsk, . .	1,205,200
43.	Wilna, . .	1,100,000
44.	Grodno, . .	753,000
45.	Volchinia .	1,212,846

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[*] In the *Russian Geographical Dictionary* of Stchekatof, Vol. v. p. 142, the empire of Russia is divided into fifty governments; and in *Vsevolojskiis Dictionnaire Géographique Historique*, Vol. ii. p. 172, it is divided into fifty-two governments. The above is Yablovskii's division, and is both the latest and the most approved.

No.	Name.	Population.
46.	Podolia, or Podolsk,	1,297,787
47.	Kiéf,	1,066,198
48.	Tcheringof,	1,260,000
49.	Poltava,	1,625,000

Provinces which do not form governments, and which are administered each according to Particular Laws.

1.	The Principality of Finland,	1,200,000
2.	The Province of Biélostock,	200,000
3.	The Kingdom of Poland,	2,800,000
4.	The Province of Bessarabia,	230,000
5.	The Land of the Don Kozáks,	250,000
6.	Mingrelia,	26,000
7.	Imeritia,	80,000
8.	Georgia (as far as is known)	371,200
9.	Leaghistan,	20,000
10.	Daghistan,	30,000
11.	Shirvan,	30,000
12.	The Khanat, or Province of Karabagh,	30,000
13.	The Khanat, or Province of Talishin,	30,000

Islands at the mouth and in the Gulf of Finland whose population is included in the governments to which they belong.

Islands in the Eastern Ocean.

1.	The Kurilian Islands, The Aleutian Islands, Islands north of the Aleutian Islands,	800
	American colonies, or Russian colonies on the north-west coast of America,	800

We shall not scruple in making liberal use of Herrmann's recent and valuable writings respecting the population of Russia.

The sixth revision, according to imperial order, was finished about the year 1812. After the invasion by the French in that year, it was desirable to ascertain the extent of the loss of population and of commerce by another revision. The seventh revision was therefore terminated in the year 1815. But unfortunately it only includes the burghers and the peasants (without the females), because they are all subject to direct taxes, and to furnish recruits, except the merchants. The government wished to be certain of the number of those who are taxed in general, and of those who serve to complete the army in particular. Herrmann has given a very interesting comparative table of the sixth and seventh revisions of the whole empire, divided into governments, the general results of which we shall here copy.

	Burghers.		Peasants.				
	Merchants.	Burghers and Artisans.	Of the Crown.	Of the Domains.	Of Different Departments.	Of Individuals.	Free Peasants.
According to the 6th Revision.	124,828	702,158	6,362,816	574,247	410,611	10,444,642	203,140
According to the 7th Revision.	85,947	744,561	6,473,017	551,807	181,929	9,815,490	98,074
	Less. 38,881	More. 42,403	More. 110,201	Less. 22,440	Less. 228,682	Less. 692,152	Less. 104,964

According to the above table, there were 17,950,137 burghers and peasants, while the sixth revision gave for the same classes 18,822,625. Therefore by these statements Russia had lost, during four years, 872,515 individuals of the two classes.

This loss appeared exaggerated, and therefore another revision was ordered in 1817, with the results of which we are not yet acquainted.

The body of merchants had diminished about a third, while that of the burghers and artisans had augmented about a sixteenth. The loss in the first corps is very great, and the progress of the other is but a small compensation, for the body of the merchants form the flower of the burghers, equally for their capital and for their improvement. These two classes, so intimately connected by their industry, have assuredly made sensible losses, notwithstanding that the state of the burghers in general appears to have been stationary in this period, for according to the sixth revision it consisted of 826,986 individuals, and of the seventh of 830,508. It appears that the greatest part of the ruined merchants have had themselves inscribed in the class of simple burghers, as this class has gained nearly that which the first had lost: the difference of 3522 souls is not very considerable, and arises from the class of peasants.—*Vide Recherches Statistiques sur la Septieme Révision*, par C. T. Herrmann. *Mémoires de l'Académie Impériale des Sciences de St. Petersbourg.* Vol. vii. p. 449.

In the eighth volume of the Memoirs just referred to, Herrmann has given two long papers which treat of the progress of population in Russia, according to the division of that empire into governments, and founded upon the fourth, fifth, and sixth revisions. His observations are illustrated by many tables, and he occasionally adds remarks of great interest on the various classes of society.

From various statistical documents the following conclusions have been drawn, chiefly founded, however, upon tables from the years 1796 to 1809. *Vide Acta Academ. Petrop. and Nova Acta Academ. Petrop.* and the early volumes of the *Statistical Journal*, published in Russian.

1. The proportion of births to the number of inhabitants is one to twenty-five for the whole empire.

2. The proportion of deaths to the total population is one to forty. In Esthonia, in Finland, in Courland, in Livonia, in Little Russia, and in White Russia, the mortality is greater than in the Russian provinces, and in Siberia. In the Krimea, in the governments of Yekaterinoslaf, Kherson, and the Kaucasus, the mortality is still greater. Though the mean number be one to forty; yet again some governments have less mortality. For instance, it is as one to fifty-four at Yekaterinburg, beyond the Ural mountains.

3. The proportion of marriages to the population in Russia is more astonishing. In the government of Sarátof it was found that there was one marriage for every one hundred and fifty souls of both sexes; in other governments two hundred and twenty marriages among

one thousand persons; and generally two hundred marriages among one thousand persons; while the most fertile countries do not reckon more than one hundred and seventy-five marriages among one thousand individuals.

4. The general proportion of births to deaths in the whole empire is sixteen to ten; but in some governments the number of births is much greater. At Tver were found twenty-six births for ten deaths; at Vologda twenty-nine for ten; at Sarátof two hundred and fourteen to one hundred.

5. The proportion of male to female births is forty-four to forty; at Sarátof one hundred and seventeen to one hundred; but the mortality of the former is also greater, being forty-three to forty, and at Sarátof one hundred and sixteen two-fifths to one hundred.

During the whole period from 1796 to the end of 1809, there were annually,

1*st*, 293,314 marriages;

2*d*, Of whom were born 1,222,823 children, or 647,702 boys, and 575,121 girls. The proportion of boys and girls was therefore as 1000 to 888.

3*d*, The medium number of deaths was 737,228 individuals, of whom 383,695 were males, and 353,532 females. The proportion, therefore, of males, was as 1000 to 921.

4*th*, Consequently there has been a surplus of births above the deaths of 485,595 souls, viz. of 264,007 males, and 221,589 females.

The mortality may be spoken of under three divisions.

1. *The mortality of children.* The mortality of children is immense in Russia, and is only equalled in some capitals. Of 1000 new-born children not more than about 555 pass the fifth year, and the half (only 498) do not attain the tenth. The mortality from the 10th to the 20th year is also very great, so that no more than 440 individuals, *i. e.* about two-fifths live to the 28th year; while in other countries one-half reach that period.

2. *The mortality of middle age.* The mortality is also great among the middle-aged. Of 1000 deaths in Russia there are 63 between the age of 20 and 30 years; 65 between 30 and 40 years; and 73 between 40 and 50 years. Only two-thirds reach the 40th, and three-fourths the 50th year.

3. *The mortality of old age.* The fourth part of the population do not pass the 50th year; for of 1000 new born, there are only 239 who reach that age. Of 1000 persons at 50 years of age, 675 reach the 60th, 350 the 70th, 127 the 80th, 32 the 90th, and three the 100th year. Nevertheless, among this small number of old people some have reached a very extraordinary age. In seven years 2084 individuals died who were above one hundred years of age, Of this number were,

1211 from 100 to 105 years.
468 —— 105 — 110 ——
164 —— 110 — 115 ——
151 —— 115 — 120 ——
52 —— 120 — 125 ——
33 —— 125 — 130 ——
2 —— 130 — 135 ——
1 —— 140 ——
2 —— 150 ——

The proportion between the annual number of deaths and of births, according to the progress of population, demands some attention. Between the years 1796, and 1809, the medium annual number of births was 1,222,823, and that of deaths 737,228, consequently there was a surplus of births over that of deaths of 485,595 individuals, or, in other words the proportion of deaths and births was as 1000 to 1658. The proportions of course have been different in different years or periods; thus, from 1796 to 1799 the proportion was 1000 to 1769 ¾; from 1801 to 1806, 1000 to 1699 ½; from 1806 to 1809, 1000 to 1539 ½. Except in the United States of America there scarcely occurs such a favourable progress in population.

The following tables comprise a great deal of interesting matter with respect to statistics, and are copied from Herrmann's dissertation. *Vide Mr. C. Th. Herrmann's Dissertations: "Resultats tirés des tableaux métriques depuis* 1796 *jusqu' en* 1809, *relevés sur ceux qui confessent la religion Gréque en Russie;"* or the *Mémoires de l'Académie Impériale des Sciences de St. Petersbourg.* Vol. v. p. 610. The reports of the year 1800 were unfortunately burned.

Table showing the annual number of Marriages, Births, and Deaths.

Year.	Marriages.	Births.			Deaths.		
		Males.	Females.	Total.	Males.	Females.	Total.
1796	260,792	533,526	456,920	990,446	274,974	253,351	528,325
1797	257,513	531,015	460,900	991,915	275,583	254,807	530,390
1798	261,087	556,700	482,335	1,039,035	318,550	292,237	610,787
1799	271,674	578,028	502,410	1,080,438	335,870	312,150	648,020
1801	298,158	627,418	552,058	1,179,476	382,157	344,114	726,271
1802	299,037	690,985	613,486	1,304,471	353,283	335,151	688,434
1803	302,467	674,068	603,253	1,277,321	412,142	379,837	791,979
1804	311,798	715,354	642,933	1,358,287	409,137	380,681	789,818
1805	287,297	716,925	644,209	1,361,134	425,072	393,361	818,433
1806		710,530	633,624	1,344,154	441,173	403,550	844,723
1807		703,622	630,970	1,334,592	454,092	411,992	866,084
1808		703,748	630,382	1,334,030	465,552	426,100	891,651
1809		678,213	623,090	1,301,303	440,457	408,589	849,046
Total.	2,549,823	8,420,132	7,476,570	15,896,702	4,988,042	4,595,920	9,583,962

Russia.
Population.

Table *of Male Deaths arranged according to their Age.*

Age of the Dead.	1798.	1799.	1801.	1802.	1803.	1804.	1805.	Total.
Between 0 — 5	133,142	127,426	167,348	150,458	196,157	191,985	207,360	1,173,876
5 — 10	26,309	16,879	20,464	26,194	19,865	20,325	19,782	149,818
10 — 15	7,827	18,726	9,383	10,535	10,163	9,565	9,890	76,089
15 — 20	10,135	11,330	11,823	9,427	11,527	10,945	11,042	76,229
20 — 25	9,471	10,087	12,875	11,990	11,795	11,285	11,647	79,150
25 — 30	11,780	11,532	13,561	10,795	12,699	12,783	13,773	86,923
30 — 35	8,708	9,521	16,240	10,460	10,351	10,645	10,968	76,895
35 — 40	12,496	12,836	14,759	10,774	14,188	14,927	14,808	94,788
40 — 45	10,190	11,589	12,274	12,906	13,126	13,215	13,156	86,456
45 — 50	10,708	15,964	15,481	12,069	16,766	17,131	17,565	105,684
50 — 55	9,875	11,208	11,491	14,032	12,481	12,596	12,762	84,445
55 — 60	15,882	17,658	17,439	11,412	18,387	19,424	18,584	118,386
60 — 65	11,239	12,959	12,151	15,528	13,795	13,901	13,894	93,467
65 — 70	15,804	16,657	16,189	11,222	17,198	17,186	17,131	111,387
70 — 75	9,713	9,099	9,576	13,424	10,782	10,438	10,104	73,136
75 — 80	6,410	10,356	9,984	7,702	10,733	10,866	10,722	66,773
80 — 85	4,212	4,553	4,936	7,222	5,219	5,051	4,930	36,123
85 — 90	2,299	3,797	3,586	3,337	3,995	4,232	4,124	25,370
90 — 95	1,261	1,499	1,402	2,087	1,431	1,501	1,392	10,573
95 —100	879	1,126	971	1,168	1,145	1,257	1,144	7,690
Beyond 100	210	268	222	479	339	279	294	2,084
Total.	318,550	335,870	382,157	353,223	412,142	409,137	425,072	2,636,151

In the eighth volume of the *Memoirs of the Academy*, we find another essay by Herrmann, under the title of *Statistical Researches on the Proportion of the Population to the Extent of the Russian Empire*, according to certain divisions. Our limits only allow us to copy the following table, which deserves a calm perusal.

No.	Names of the Governments.	General Population of both Sexes in 1810.	Extent in Square Miles.	For each Square Mile.	Result.
1	Moscow	1,108,208	474	2,323	14 Governments well peopled.
2	Poltava	1,391,626	718	1,938	
3	Kiéf	1,137,281	593	1,917	
4	Tula	896,972	498	1,801	
5	Kursk	1,212,703	677	1,791	
6	Riasan	903,769	613	1,474	
7	Kharkof	844,636	595	1,419	
8	Kaluga	750,967	553	1,358	
9	Yaroslaf	797,641	606	1,316	
10	Vitebsk	707,638	550	1,286	
11	Orel	1,024,564	803	1,275	
12	Mohilef	806,763	683	1,181	
13	Courland	387,439	337	1,149	
14	Vladimir	907,469	802	1,131	
15	Vitebsk	1,112,783	1132	983	18 Governments moderately peopled.
16	Tambof	1,029,778	1072	961	
17	Belostock	193,903	206	936	
18	Tchernigof	1,077,662	1170	921	
19	Pensa	745,574	777	920	
20	Nigegórod	879,897	961	819	
21	Somelensk	919,828	1008	912	
22	Pleskof	719,781	795	905	
23	Tver	1,009,249	1135	889	
24	Grodno	586,836	675	869	
25	St. Petersburgh	666,669	774	861	
26	Podolsk	1,138,868	1327	858	
27	Kazán	827,000	1044	792	
28	Esthonia	211,170	304	694	
29	Voroneje	979,426	1434	683	
30	Vilna	810,391	1284	631	
31	Simbirsk	854,090	1402	609	
32	Livonia	573,611	953	601	

Table Continued.

No.	Names of the Governments.	General Population of both Sexes in 1810.	Extent in Square Miles.	For each Square Mile.	Result.
33	Minsk	845,248	1755	481	8 Governments very thinly peopled.
34	Kostrom	813,132	1808	449	
35	Viatka	949,983	2221	427	
36	Novgórod	635,781	2063	308	
37	Taurida	253,825	831	305	
38	Wiburgh	195,822	781	250	
39	Kherson	280,406	2876	242	
40	Yekaterinoslaf	416,559			
41	Sarátof	821,862	4292	191	
42	Perm	940,078	5039	186	
43	Orenburg	736,725	5620	131	
44	Vologda	606,547	8406	72	
45	Olonets	199,549	3147	63	
46	Astrachán	68,681	5742	22	
47	Kaucasus	62,773			
48	Archangel	201,305	12,131	16	
49	Tobolsk	427,066	85,387	8¾	
50	Tomsk	293,967			
51	Irkutsk	376,720	127,068	3	

We shall conclude the bills of mortality by the most recent table which we possess.

According to the lists of the births and deaths in the Russian empire during the year 1821, it appears that

The births were, .	1,545,679
deaths, . .	945,088
excess of births,	600,591

The number of births was, however, 27,720 fewer, and that of deaths 27,408 more, than in 1820. Among the deaths were—

17,336	above	80	120	above	110
4,575	above	90	78	above	115
1,999	above	95	49	above	120
724	above	100	16	above	125
221	above	105	5	above	130

one obtained to the extreme age of between 145 and 150, and one the decrepitude of between 150 and 155 years. The first was born in the government of Mohilef, and the second in that of Tambof.

No empire in the world consists of so many nations so dissimilar in their origin, and languages, and manners, as the Russian. Within its circuit are included above a hundred nations and tribes, who speak at least forty different languages, and who may be arranged under eight great classes:

1. The SCLAVONIC, . . . 38,800,000

Proper Russians, Little Russians, Kozáks, Poles, Lithuanians, Lettes, Courlanders, and Raitsens or Servians.

2. The FINNISH, ... 2,376,000

The Proper Fins, Esthonians, Livonians, Laplanders, Permians, Zirianes, Vogoules, Tchusarhes, Tchevemiss, Votiaks, Mordvas or Morduans, the Ostiaks of the Ob, Teptiars.

3. The TARTAR, ... 1,850,000

(a) Proper Tartars, as those of Kazán, of the Krimea, of Astrachán, of the Ob, the Turalintsi, the Barabintsi, the Katchintsi, the Kistimeri, the Tulibertsi, the Biriuses, the Abintsi, the Verchotomskiyé, the Sayanes, the Beltiri.
(b) Nogay or Kubán Tartars, Tauridan, Astrachán wandering Tartars, Kundurskiye, Kumikens, Basianers, (c) Truchmenians, (d) Kirghis, (e) Aralians, (f) Karakalpaks, (g) Tchivintsi, (h) Bucharians, (i) Mestcheriaks, (k) Bashkirs, (l) Teleuntians, and (m) Yakuti.

4. KAUCASIAN NATIONS, . . 1,200,000

Circassians, Georgians, Avtchases or Abassi, Lesghi, Ossetinians, Kistintsi, the Tchitchentsi, the Mikshesi, Karabulaks, and Yugushi.

5. The MONGOLE, ... 300,000

Mongoles, Kalmuks, Burati, and Kurilians.

6. MANDSHURES, ... 80,000

Tungusi and Lamutes

7. POLAR NATIONS, . . . 300,000

(a) The Proper Samoyedes, Koibali, Soyotes, Matori, Tubintsi, Kaimashi, and Karagassi.
(b) Koriaks, Tchuktchi, Yukhagirs.
(c) Jurales, (d) Arintsi, (e) Assani, (f) Kotovtsi.
(g) Ostiaks, (h) Kamschadals, (i) Kurilians, (k) Aleutians.

8. COLONISTS AND INHABITANTS OF MOLDAVIA, ... 800,000

Germans, Swedes, Danes, English, French, Greeks, Armenians, Persians, Hindoos, Arnaouts, Vallachians, Osmans, Moldavians, Bulgarians, Gipsies, and Jews.

THE NAVY.

According to Cromé and Hassell, in the year 1805, the Russian navy consisted of 32 ships of the line, 18 frigates, 59 small craft, and 226 gallies. Taken together, they make 355 sail, which carry 4428 cannons, with 33,507 sailors, 4000 naval artillery, and 8262 marines. Of these are stationed in the Baltic Sea, 26 ships of the line, 14 frigates, 6 cutters, 19 small craft, and in the galley fleet, 2 gallies, 81 cannon-boats, and 88 other vessels, together with 2965 cannons.

In the Black Sea, 12 ships of the line, 4 frigates, 7 brigantines, 18 small craft, and in the galley-fleet, 40 cannon-boats, together with 1257 cannons.

In the Caspian Sea, 6 small craft with 70 cannons. At Ochotsk, 11 small craft with 36 cannons.

We believe that the Baltic fleet is rather increased than diminished since 1805; and we know for a certainty that more than one half of the large ships are laid up in the fine harbour of Cronstadt, and are nearly rotten. In the year 1822, the fleet of the Black Sea consisted of 14 ships of the line, 10 frigates, besides numerous small craft, as gun-boats, &c. *Vide* Lyall's *Travels*.

ARMY.

Army.

Although different Tsars are said to have organized an army, yet it was not till the time of Peter the Great that Russia possessed any thing like an *European* army. Our limits do not allow us to give its progressive history. We must content ourselves by stating the facts, that this country, which, little more than a century ago, had only two or three hundred thousand soldiers, which were looked upon with indifference by the other powers of Europe, has of late spread her conquering troops over different states of this quarter of the globe, and of Asia, and at this moment consists of nearly a million of men.

The statements of different authors will give us correct notions of the progress and state of the army in modern times.

According to Hassell, the army of Russia consisted of 558,120 men, viz. (1.) The guards, seven regiments, three battalions, one company, 13,103. (2.) Infantry, 138 regiments, 38 battalions, 317,110. (3.) Cavalry, 47 regiments, 54,022. (4.) Artillery, 2 regiments, 17 battalions, 12 companies, 62 commandos, 44,052. (5.) Invalids, 62 companies, 30 commandos, 13,920. (6.) Irregular troops, including the Don Kozáks, 40,000; the Tchernomorskii Kozáks, 3468; the Ural Kozáks, 5780; the Boog Kozáks, 1500; the Stavropole Kozáks, 1000; other Kozáks, Kalmucks, Bashkirs, Tartars, 48,632; free Greek battalion, 534. Altogether, besides the irregular troops, 194 regiments, 60 battalions, 75 companies, 92 commandos, 13,682 staff-officers and officers, 1297 under staff-officers, 543,141 under officers and privates, who are under fourteen *military inspections*. To this army is to be added, since 1806, a national guard, or militia, of 612,000 men.—*Staats und Address-Handbuch*, p. 227.

A Russian historian tells us, that in 1807 the army of his country was formed of 670,000 regular forces, more than 100,000 Kozáks, and about 100,000 of reserve for filling up vacancies in the armies; the Swedish, the Polish, the Turkish, the Georgian, and the Siberian. The same author adds, that *without oppressing foreign nations, and without destroying herself*, Russia can maintain a million of forces in time of peace; a position which we suspect is false.—*Ruckoya Istoria, or Russian History of Glinkii*, vol. viii. p. 344.

By Hassell's statement, in the work formerly referred to, in the year 1815, the Russian army was formed of field troops 422,822; garrison troops 84,300; engineers 1113; invalids 13,920; and 110,000 irregular troops.

Cromé reckoned the land forces of Russia at 450,000 in time of peace, and at 639,415 when on a footing of war. The last number is said to have been that of the army in 1811, and of course previous to the memorable invasion of the French. According to this author, the composition of the Russian army is well known, and consists of

I. The imperial guards,	
a) 1 regiment and 3 battalions infantry,	12,150
b) The horse guards, 7 regiments,	4450
c) The artillery-guards, 600 men, together with the whole foot guards,	17,200
II. Field troops,	
a) Infantry, 141 regiments, troops of the line, and 3 regiments marines,	317,360
b) Regular cavalry, 58 regiments,	57,000
c) Field-artillery (with 1530 pieces of cannon),	29,522
d) Corps of engineers,	1113
III. Garrison troops,	
a) Infantry,	72,800
b) Artillery,	11,500
IV. Invalids,	13,927
V. Irregular troops,	
a) 33 regiments of Kozáks, b) The Kalmuck forces, c) The Bashkirs, &c.	100,000

After alluding to the 612,000 militia already spoken of, Cromé adds, that Russia can defend herself with above 1,200,000 warriors.—*Allgemeine Uebersicht des Staatskräfte*, 1818.

Though the Russians lost a great number of troops in the eventful years of 1812,-13,-14,-15, they were compensated, in a great degree, by the knowledge and experience acquired during the campaigns. Alexander had an opportunity of detecting the deficiencies of his own army, and of improving his millitary skill, by seeing and combating with the finest armies of the world; and his officers enjoyed the same advantages. Ever since his return to his country, in 1815, the Emperor's great attention has been given to the better organization and discipline of the army, and beyond all question an immense improvement has been the result.

For a few years past, it has been generally reckoned that the Russian army consists of a million of men. The officers vary in their statements, some estimating its number as low as 800,000, while others maintain that it amounts to 1,200,000 troops. According to a paper in the first number of the *Westminster Review*, the official reports fix the number of the autocratic army at 950,000, but the writer conjectures that this exceeds the real number by one-third. The following statement is also given, but upon what authority we are not informed. It is believed to be correct, and was made after a reduction of about 30,000 men, which took place a few months ago, the whole of which have been incorporated into the military colonies.

			Men.
First army, Gen. Sacken,	—head quarters,	Mohilef	320,000
Second army, Gen. Wittgenstein,	——	the Pruth	100,000
Imperial Guard, Gen. Uvárof	——	Petersburgh	80,000
Georgian army, Gen. Yermlólof	——	Tiflis	60,000
Lithuanian army,	——	Wilna	80,000
Polish army,	——	Warsaw	30,000
Disciplined Kozáks,			7,500
			677,500

Upon this table, Dr. Lyall remarks, that the words *Georgian army* appear to include the whole army commanded by General Yermólof, in the Kaucasus and Georgia, and adds that that army has often been estimated as high as, and even above 100,000 men; and also as in the above report, at only 60,000. He is of opinion, however, that the medium number 80,000 is near the reality. The disciplined Kozák army has never before been estimated so low as 7500, and he says, 20,000 at least would be a near approximation to truth, and in this statement he is supported by other authors.

As the subject is intimately connected with the army, we shall give an outline of the recently adopted plan of military colonization, for which we are wholly indebted to Dr. Lyall.*

The great expence of providing for an army amounting to nearly a million of men, induced the Emperor of Russia, soon after the conclusion of the late war, to direct his serious attention to every plan which was offered for supporting the soldiers in the most economical way. Count Araktcheef, who had risen from the ranks, solely by his great talents, to become a general of artillery, and to be one of the chief military counsellors attached to the person of the emperor, is said to have first suggested the idea of quartering the soldiers upon the crown-peasants, of building military villages according to a regular plan, of allotting portions of land to each house, and of framing a code of laws for the government of these new-created colonies.† This system of military colonization, which has been adopted within these few years, presents a new feature in the history of Russia and of Europe, indeed, in some respects of the world. Its peculiar nature will be at once perceived by the following summary: 1st, For the formation of these military colonies, no part of the inhabitants is sent out of the empire, there being a great superabundance of territory in proportion to the population. 2d, The peasantry, who are already *civil slaves*, by this plan, are absolutely made both *civil* and *military slaves*, and are in the mean time burthened with the support of regular troops; and indeed, in time, nearly the whole army is to be formed from among them. 3d, As they are governed by a code of laws peculiar to themselves, so they are not directly dependent upon the general legislature of the country, nor are they independent of it, because all their laws emanate from a committee at Petersburgh; which, after receiving his Imperial Majesty's signature, are put in force. 4th, Like some of the Roman colonies, they are both of an agricultural and of a military nature.

The objects the Russian government has chiefly in view by the establishment of the military colonies, some of which are peculiar, are chiefly the following: 1st, The increase of the native population in certain districts, by the transfer and fixture to them of part of the existing regular troops, and even of peasantry when requisite, and of course, by the progeny of both; 2d, The extension of knowledge and civilization; 3d, The saving of the greatest part of the pay of the whole army to the crown; 4th, The organization of an immense army to be employed in agriculture in time of peace, and to form nearly the whole land force of the empire in time of war.

Military colonies are already in part organised, and no doubt will be more extensively organized, in a line stretching from near Petersburgh, along the borders of Poland, and toward the boundaries of Turkey: the chief points where Russia now requires to have powerful forces, whether with a view to make an irruption into other countries, or for the defence of her own frontiers, for she is neither to be regarded as inaccessible, unattackable, nor unconquerable.

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* An account of the organization, administration, and present state of the military colonies in Russia. 1824.

† This plan met with the immediate approval of the emperor; and, indeed, some are disposed to think this part of the system originated with his Majesty.

The system of colonization will be best understood by a detail of the course adopted to colonize a single regiment. The emperor issues an ukás, in which are indicated the crown-villages which are to become military colonies. In the villages so designated, (which are inhabited by crown-peasants, and consequently are at the emperor's disposal,) the name, age, property, and family of each householder are registered; those who are above 50 years old are chosen to form what are called the *Master-colonists*. Houses are built for them in lieu of those they inhabited, forming a street or streets of cottages similar to one another, each separated from the neighbouring cottage by a court-yard, and each master-colonist receives fifteen deciatins, about forty English acres; with this condition annexed, that he is to support a soldier, his family, if he has one, and his horse, if cavalry are colonized in the village; he receiving the benefit of the soldier's assistance in the cultivation of the land and other duties of husbandry, when not engaged in his military duties. In seed-time and harvest-time, it is understood that the soldiers are to be little exercised, in order to leave them free for the labours of the field. As many of the present *Agriculturist-Soldiers* have formed part of the regular army, the master-colonists need scarcely expect much assistance from their exertions. When a new progeny shall have taken their places, who have been trained from their youth to agriculture and to arms, perhaps the dissimilar union may become more assimilated.

The soldier, who becomes domesticated in the house of the master-colonist, shares his table, and assists him in his labour, is called *Agriculturist-Soldier*. Close to the house of the master-colonist is built one exactly similar, which is occupied by the *Reserve*, who may be considered as the soldier's second self. He is chosen by the colonel of the regiment colonized from the peasants, and is usually a son or relation of the master-colonist. The *Reserve* is instructed in every part of a soldier's duty, and qualified in every respect to take the place of his prototype, or to form one of an army of reserve in case of danger. He too assists when wanted in the cultivation of the fifteen deciatins of land, or follows such other occupation as may suit him, tailor, shoemaker, and so on.

The master-colonist, agriculturist-soldier, and reserve, may choose their wives where they like, and are encouraged to marry; but the women, once within the pale of the military colonies, cannot marry out of them.

The sons of the master-colonist, agriculturist-soldier, and reserve, who are from thirteen to seventeen years old, are called *Kantonists*, are exercised as soldiers, and continued at the village which is the residence of the Colonel, and the head-quarters of the regiment: they also occasionally attend school to complete their education.

The boys from eight to thirteen years old go to school in the village in which their parents reside, and learn their military duties alternate days; they as well as the Kantonists are dressed in uniform, and considered as soldiers; the children under eight years old remain with their parents.

The education of the children forms a very important feature in the system. All the male children in the colony are sent to schools of mutual instruction, where they are taught reading, writing, and arithmetic. They learn a sort of catechism containing the duty of a soldier, much the same as that which Buonaparte taught his soldiers. They are instructed in the use of the sword; learn to ride in the *Manège*, and after the age of thirteen, they are assembled at the head-quarters of the regiment, and formed into a corps, in which those who distinguish themselves most by their quickness and attention are made officers. At Voznesénsk, (the head-quarters of the first regiment of the Boog) Dr. Lyall saw a body of 200 Kantonists who marched, fired, and performed all the evolutions of experienced soldiers, with a steadiness and precision which was astonishing. There was an *esprit de corps* about them, which cannot fail to make them good soldiers.

The education of the women has hitherto been much neglected, but they have now begun to establish schools on the Lancasterian plan for them, which, no doubt, will soon become general.

A military colony, therefore, consists of

1. The *Master-Colonist*, so called because he is master of the family and of the farm.
2. The *Assistant*, so called because he aids the master-colonist in cultivating the ground.
3. The *Agriculturist-Soldier*, who adds to the usual military duties the occasional one of assisting in the fields.
4. The *Reserve*, who, like the agriculturist-soldier, combines the two capacities of soldier and agriculturist; and, as the name implies, forms one of a *corps de reserve*, to supply the soldier's place in case of necessity.
5. The *Kantonist*, under which head are comprised all the *boys* in the colony from thirteen to seventeen years old.
6. The *Boys* from eight to thirteen years.
7. The *Male Children* under eight years old.
8. The *Females*.
9. The *Invalids*.

The administration of the military colonies deserves particular attention, as it separates their interests completely from that of every other branch of society in the Russian dominions.

The colonies in the south of Russia occupy 380 villages in the Governments of Kherson, Kharkof, and Yekaterinoslaf. The villages, according to their size, contain from two squadrons to half a squadron. In each village is stationed half a battalion, a battalion, or even two battalions of infantry, in the Government of Novgórod; and the number of troops there amounted, in 1822, to 24,000 men.

In the above 380 villages, were colonized, in the summer of 1822, twelve regiments of lancers, and twelve of cuirassiers, forming a total of 24,000 men. The total number of colonized forces, therefore, amounted to 48,000 in 1822. At present they may be estimated at 80,000 soldiers.

The three Governments above mentioned constitute a military district, which is placed under the command of General Count de Witt, from whose jurisdiction there is no appeal but to the emperor, and that only in particular cases. Count de Witt is entitled commander-in-chief of the military colonies in the governments of Kherson, Kharkof, and Yekaterinoslaf.

A code of laws, consisting of fourteen volumes, has been compiled by a committee appointed for the purpose at St. Petersburgh, for the special use of the military colonies.

These laws are administered, in the first instance, by the committees of the squadrons: each squadron having a committee composed of its officers, one of whom is elected president. These committees take cognizance of small offences committed in their respective squadrons: the term squadron including not only the soldiers who form it but the colonists belonging to it.

From the decision of this committee, there is an appeal to the regimental committee of administration, consisting of the colonel, who is president, the lieutenant-colonel, who is vice-president, two captains, and six deputies chosen by the colonists, one from each of the six squadrons composing the regiment. The decisions of this regimental committee are referred to Count de Witt for his approval, and from his decision the soldiers and colonists have no appeal, even though it should extend to sending them to Siberia, the *ne plus ultra* of Russian punishment. Officers may appeal from Count de Witt's decisions to the emperor.

Great offences are usually tried by a Commission appointed by Count de Witt, a sort of court-martial.

A very inquisitorial police maintains the good order of each colony. A subaltern officer goes every day into each of the houses and makes his report of the state of the inmates; and on parade days, the master-colonist and his assistant appear at the door of their cottage to show themselves to the inspecting field-officer.

At the head-quarters of each regiment is its chancery, in which the code of laws is deposited, where the committee of the regiment meet, and a number of clerks are employed to keep the accounts, and register the proceedings.

In most of the military villages are churches where the priests officiate who belonged to them, before they were included in the colonies.

Such an *imperium in imperio* can hardly subsist with impunity to the parent-state, unless its energies are directed against foreign powers; and, if this idea is correct, under a warlike sovereign it may operate the subversion of all the established dynasties of Europe; under a weak one, the partition of Russia may be looked upon as likely to result from the explosion of its latent powers.

It must be observed, that the millions of troops so colonized and trained exist hitherto only on paper; and from a variety of circumstances, general and local, it seems utterly impossible that even one million of troops should be so organized. The world is not likely to sit idle while Russia organizes so vast a force; and besides, this gigantic system contains in its bosom the seeds of its own destruction.

Among other sources of opposition to the scheme, its general unpopularity is likely, very soon, to give it a death-blow. It is held in utter abhorrence by the peasantry; it is detested by the regular army to such an extent, that the government is obliged to give the officers a higher degree of rank, and additional pay, in order to induce them to attach themselves to colonized regiments; and it is highly disapproved of by all classes of the nobility.

The nobles regard the plan, and apparently with much justice, as highly dangerous to the empire. For, suppose a popular leader, especially in the south of Russia, should differ with the government, or with his sovereign, after a few hundred thousand men were first taught to obey him, and afterwards obeyed him through attachment, what might not he effectuate?

When the experiment of *colonizing* was first made in the neighbourhood of Novgórod, it produced much discontent and some disturbances. The peasants seem to have resented the ingrafting a soldier on their *ménage* as an infringement of the liberties even of slaves. They might exclaim with Melibæus;

> *Impius hæc tam culta novalia miles habebit?*
> *Barbarus has segetes?*

and the resolution that the oldest peasant in the colonies should so far conform to military rule as to cut their hair and shave their beard, added fuel to the flame.

Nor has the system of military colonization been carried into effect, without serious difficulties also in the south of Russia. Its institution was followed by discontent and murmurs, which sometimes went so far as to cause disturbances, and to threaten revolts. The poor peasants loudly and generally complain of being restrained in their dwellings by the severe military police; and bitterly regret their fate in being forced to become colonists. Their former state of *civil slavery* seems perfect freedom in comparison of the new military arrangement of affairs.

Many affecting scenes are said to have taken place, as the empress and the dowager-empress went to and returned from Moscow, in the year 1818. Hundreds of the peasants collected at the post-stations, and when the imperial carriages stopped, they simultaneously bowed themselves to the earth, or completely prostrated themselves, and in the language of the deepest sorrow and distress entreated their majesties to hear their tales of woe, and to intercede with the emperor to abandon the new system of colonization.

Notwithstanding the extreme unpopularity of the system of colonization, and the vehement and general opposition which it has met with, it still goes on, and government seems determined in its prosecution. We have not the smallest doubt, however, that all its ends will be defeated and terminate in an aërial castle.

In conclusion of this department, we may remark, that notwithstanding the immense alarm which has been sounded throughout Europe by some authors of respectability, as to the enormous and increasing power of Russia, there seems no great cause for uneasiness. The army of Russia is great to be sure, but it wants moral energy, and it is scattered over an immense extent of territory. We must not fear the numerical force of Russia upon paper, but look to the number of effective troops she could lead beyond the Niemen or the Vistula. So long as a combination of European powers is able to hold Russia at defiance, and so long as it shall be the interest of those powers to keep her within due limits, we have no fear of her legions of troops, her hordes of Kozáks, and her bands of Tartar and Siberian wanderers.

CIVIL ADMINISTRATION.

Civil Administration.

In the Russian empire, all power is concentrated in the monarch. He is assisted by his cabinet-council, his ministers, the directing senate, and the holy synod; but he can over-rule the decisions of them all.

Each of the governments of Russia has a military and a civil governor, who are the representatives of the Emperor, who direct the administration of their provinces, and whose residence is in the chief town of the government. In a few instances the same military governor has command over more than one government, as is the case with the governments of Kherson, Kharkof, and Yekaterinoslaf, and those of the Kaucasus, and Georgia, &c. Each Government town has numerous tribunals, as in other countries, for the various cases which occur in civilized society, and each district town has courts of justice subordinate to those of the government. The senate, of which some divisions are at Petersburgh, and some at Moscow, is the highest tribunal for civil affairs, as the synod is for ecclesiastical matters. From their decisions an appeal may be made to the cabinet council, or to the Emperor himself, and then the final determination takes place.

But it is impossible for us to enter into all the details of the different courts. We must confine ourselves to general views of the present state of administration.

It was in vain that the Empress Catharine II. declared, that in the Russian empire, the various classes of the subjects should enjoy their peculiar rights; that reputation, property, and life, except in criminal cases, should be inviolable, and that the laws should be enforced, and all causes determined by them. It was still more nugatory that she pronounced that no man should be condemned unheard, that even a traitor, or a rebel, should enjoy the benefit of defence, and that, when a man was injured or supposed so, he might make a representation and expect relief. There is no doubt that an abuse of power by violent rulers and inconsiderate ministers, by rapacious governors and venal judges, often defeated the intentions of that monarch, Catharine, by the invasion both of public and private rights. After her death no new measures were taken for the improvement of the civil administration, and corruption became daily more extensive. On the ascent to the throne of the present sovereign, the administration of justice was in a lamentable condition; and notwithstanding a few meliorations made by Alexander, the subject has but lately made a sufficient impression on his mind. For many years past his attention has been too eagerly occupied with his armies and with war; but in this season of peace, we are glad that he proposes to make important changes in the civil government of the empire.

That there is great want of change, is evident from the present corrupt state of all the departments of the administration. Indeed the civil administration in Russia is excessively defective. The bribery and corruption which characterize the courts of justice in this country have been dwelt upon by various authors. Dr. Lyall confirms their accuracy, and says, it is melancholy to reflect that there is no prospect of a speedy or extensive check, not to speak of a cessation of these evils. Indeed, the disease is deeply complicated with the constitution of the government. The universal inadequacy of the annual salaries granted by the crown for the support of the rank, nay, of the existence, of those employed in the tribunals, and in the other branches of the civil department, in the army, and in the navy, is a well-known fact. Most individuals endeavour to support their rank in life agreeably to the usages of civilized society. If those, in the service of any government, have no revenue besides inadequate salaries, it follows, of course, that they must either act inconsistently with their rank, resign their places, or resort to some plan for bettering their incomes. Now this is exactly the condition in which persons in all the departments of the Russian service are placed; and it is not difficult to divine which of the three alternatives is generally chosen, especially as that alternative, sanctioned by usage, has become universal, and of course its adoption is not accompanied by disgrace. A system once established universally throughout a great nation, of receiving presents or recompenses in money or kind, from those who seek the good graces or the interest of the officers of the crown, would require strong measures and time for its melioration and destruction. The foundation of a reform would be the bestowing of salaries on those officers adequate to their rank, so as to render them independent. To do so speedily is next to impossible; and it will probably be effected at a remote period, unless some revolution of Europe, or of the empire itself, give a new aspect to affairs. The present corrupt system has been consolidated by time, in spite of the efforts of two of the greatest and wisest sovereigns who ever wore a crown. Indeed, the comparatively small augmentation of government salaries, since the time of Peter the Great, notwithstanding the greatly diminished value of the roubles, the more general adoption of civilized customs and manners, and the consequent increased expense of the mode of living, seems more and more to have rivetted the mischief. The depreciation of the currency to 75 per cent. has reduced almost to nothing the former insufficient salaries of all the departments of the public service.

The same author speaks of the corruption and bribery of the administration in the cabinet council of his imperial majesty; he illustrates it in the system of police—in the post-offices—in the custom-houses—in the army—in the navy;—and in the civil, military, and naval divisions of the medical department, and then concludes his dreary view in these remarkable and painful words: "The whole system of the administration of Russia is like the tissue of a decayed spider's web, or rather, like the centre of an immense wheel, held together by rotten spokes; corruption supports corruption, rottenness props rottenness; and this explains how the machine still continues its onward progress. Should a *slight concussion* be perceived in one part, there is a *sympathy* of the rest by which its force is uniformly diffused throughout the whole, and no single part gives way; for when one part gives way the whole will fall; and that, apparently, will not happen until liberty give a death-blow to despotism."

We shall conclude this subject by referring the reader who is curious about it, to Dr. Lyall's work, and to two works which lately issued from the press, the "*Narrative of a Pedestrian Journey through Russia and Siberian Tartary in the years* 1820, 1821, 1822, and 1823, by Captain John Dundas Cochrane, R. N;" and "*Travels through Russia, Siberia, &c. in* 1822, 1823, and 1824, by James Holman, R. N." These last volumes contain numerous details in proof of the accuracy of Dr. Lyall's general views. They but too truly demonstrate the sufferings of a people oppressed by their rulers, their chiefs, and their superiors, and exhibit the woful state of society, where the few have the power and the inclination to enrich themselves by the labours, the toils, and the property of the many.

But, as Dr. Lyall remarks, the terms bribery and corruption require some explanation in connection with Russia. In most countries by bribes are understood sums of money promised or given, in order to pervert justice and gain one's cause: by corruption, the act of being unjustly influenced by bribes. In Russia, though the same definitions be frequently applicable, yet the more general intention and utility of bribes, genteelly called presents, is to excite a person to do his mere duty, and to recompense him for his time and trouble. In fact, these presents may be said to form the receiver's chief salary. Wherever such an execrable system is once generally established, though despised by every generous mind, yet it is fair to regard the infamy attached to it, as infinitely less than that of accepting bribes in courts of justice, where nothing of the kind is expected or recognised; because, in the one case, both parties in a cause have the same channel of procedure open from the commencement; in the other, the process may be finished, and the detection of corruption on one side be too late for the other party to counterbalance his antagonist by the same weapons.

The cabinet statesman will easily find a cure for the evils spoken of, by increasing the taxes; giving adequate salaries to the officers of the crown; issuing severe edicts; and punishing delinquents with rigour. But he who contemplates the great machine, and the thousands and millions of dependent wheels in full motion, and who knows the genius of the natives of Russia, will speak more rationally. He will see, that though immense sums be paid *indirectly by a part of the population* who have affairs in the courts of justice, yet that the sovereign, who would attempt to impose the same sums *in direct annual taxes upon the general population*, would run the risk of causing a speedy revolution, and of being hurled from his throne. Every enlightened sovereign who wishes to improve his people will carefully remark their constitution, equally with respect to religion, civil administration, and political economy, and will reflect well before he takes new measures. Beyond all doubt the present monarch of Russia is well acquainted with the state of his nation under all these points of view; but like a wise politician, who is familiar with the genius of his people, who has the good of the realm at heart, and who, from the history of the world, perceives the madness of attempting to effect, in one reign, what must be the effect of scores of years, probably of centuries, he proceeds with a cautious, steady, and determined pace. He is paving the way for the emancipation of future generations from vassalage, he has lately made extensive changes, and it is to be hoped improvements, in the administration of justice in Siberia, and according to the public press, he is now occupied in the reform of the tribunals throughout his wide-spreading dominions. He has begun a reform which will reflect honour upon his memory, and which his successors may complete, though centuries hence. But it were to be wished still that his Imperial Majesty's attention were more devoted to this subject, and that he were more ardent with respect to civil affairs in general. We anxiously hope that the time will soon pass away when princes of the blood will cease to repeat, within the walls of the imperial palace, such sayings as the following: "*Quand je vois un officier civil il me donne mal au cœur;* a sentence which but too truly portrays the taste for military pursuits. *Vide* Lyall's *Travels.*

LANGUAGE.

Language.

The Russian language, as well as the Polish, Bohemian, &c. is a dialect of the Sclavonic. The latter has forty-two letters, while the former, at present, only admits thirty-five letters. The Russian language has some letters peculiar to the Sclavonic dialects, and of course, many singular sounds and combinations of sounds in syllables and words. Others of the letters are familiar to us in the Greek and Latin alphabets. The Russian language is very little known beyond the districts in which it is spoken. Its structure and modes of expression are characteristic, and sometimes obscure, which render it no easy task, even for foreigners who have spent the greatest part of their lives in Russia, to acquire a moderately good pronunciation, or to speak with general correctness. These difficulties overcome, it is found that this language, so far from being harsh, irregular, and barbarous, as has been represented by some, is regular and copious, smooth and harmonious, varied and elegant. Its acquisition, besides, opens a new field for those of a literary taste, which has been little examined by British writers; though the Germans have reaped a copious harvest from it. Of late, however, it has been brought into considerable notice by the publication of Bowring's Russian Anthology, and Lyall's Preliminary Dissertation on the Russian language in the "*Character of the Russians,*" &c.

LITERATURE.

Innumerable facts sufficiently demonstrate the lack of knowledge, and the necessity of instruction among millions of the Russians. Yet the account which Dr. Lyall gives of the present state of literature among the nobility, and even among a few of the merchants, is highly gratifying. The time is not very distant, when half a dozen book-shops were not to be found in either of the Russian capitals; but this number is now much augmented; and all the government towns, and even some of the district towns of the empire, can boast of one or more. Indeed, at the present moment, the jealousy, the activity, and the emulation of the native booksellers, are as remarkable at Petersburgh and Moscow as among those at London and Edinburgh; and the pages of the Gazettes are continually filled with advertisements of new publications. Among the foreign booksellers there is less rivalship. No doubt, many of the works which issue from the press are of little or no value, and a greater number are translations. One important inference, however, may be drawn from these facts, viz. that a *reading public* is formed, and is augmenting; for if books did not sell, the Russians, more than others, would not persevere in printing them. Of late, the native poets, and the native historians, have contributed much to the literature of their country; but still much valuable information, especially with regard to history, lies buried in Scythian and Sclavonic manuscripts, and within the walls of those abodes of sloth, the monasteries.

Russian literature was never so flourishing as at the present day,—a fact which is completely proved by the number of periodical publications which issue from the press. At Moscow are published two newspapers, the Moscow Gazette, and the Senate Advertiser, and seven journals, besides the Journal of the Imperial Society of Agriculture, and the Memoirs of the Society of Belles Lettres, of the Imperial Society of Natural History, and of the Physico-Medical Society. At Petersburgh the following newspapers are published: the Petersburgh Gazette, in Russ and in German, (separate); the Russian Invalid, in Russ and in German, (separate); the Senate Gazette; the Senate Advertiser; the Price Current; and *Le Conservateur Impartial*, and eleven

Journals, besides the Transactions of the Academy of Sciences, of the Free Economical Society, and of the Society of Belles Lettres. In these journals, almost every subject is treated of with respect to arts and sciences and general literature, especially history, statistics, geography, and natural history. With respect to politics, only such information is made known to the public as the government, through its organs the censors, may please. While we lament the fettered state of the press, we cannot but remark the advance of mind to which the above list of periodicals bears testimony.

The number of universities, of academies, of gymnasia, of public schools, of private schools, of Bible Societies, and of other similar institutions in Russia, taken collectively, and in connection with the above facts, shows that a mighty engine is at work in the civilization of that empire. No doubt many difficulties oppose themselves there, to the wonted effects of such institutions in a free country; yet their number must have a considerable influence toward the civilization of at least a part of the population. The adoption of the Lancasterian system of education will also have a powerful effect. It is put in practice in the army, among the Kozáks, and even by some of the noblemen among their slaves. The imperial army, amounting to a million of men, when better educated, as they are scattered over the Russian dominions, cannot fail to have much influence upon the manners, and to tend to the illumination of the people. When it is also kept in mind, that the number of officers of that army amount to above fifty thousand; that many of them have received a good education, have served during the last campaigns, and have carried back to their country some of the learning, of the usages, and of the liberal opinions of other nations, it seems but natural to argue such an advance of civilisation of the people, as may tend gradually to loosen the shackles, if not to break asunder the chains of despotism, and to the attainment of a higher rank in the intellectual world.

The arts of printing and engraving are making great strides in the north, and daily furnish specimens which would do honour to any nation. Bookbinding is also arrived at much perfection. The art of making paper is likewise astonishingly improved of late years. So that all the agents and materials for the composition and publication of books are now abundant in Russia; and even the number of authors, translators, and compilers, is become superabundant. The number of printing presses employed in each of the capitals is considerable, and engraving is likewise encouraged. Some of the engravers are natives, and others are foreigners. At the imperial Depôt de Cartes, at Petersburgh, scores of young soldiers are daily employed in engraving maps and plans of every part of the Russian empire, many of whom have made great progress. In this magnificent institution, these maps, executed in the most detailed, accurate, and beautiful manner, are sold at very moderate prices. It is truly a depôt; for it contains immense collections of maps, indeed of every thing that can be procured with regard to the geography of the world; and it is supported in an imperial manner by the Emperor Alexander.

ARTS AND SCIENCES.

The arts and sciences were chiefly introduced into Russia after the ascent of Peter the Great to the throne, and have ever since continued to flourish to a certain extent. Their sphere of influence, however, is in a great degree confined to the universities and academies, at which both the professors and the pupils are necessarily supported by the crown; the government being despotic, and the mass of the population slaves. By the laudable efforts and valuable publications of numerous public bodies towards general improvement, much has been done, but still more remains to be accomplished. With the gradual advance of Russia in civilization, no doubt the arts and sciences will make a simultaneous progression, and, after a lapse of time, become generally cultivated, as in the more enlightened states of Europe.

EDUCATION.

Education.

The system of education in Russia is domestic or public. The rich, and even many of the poor nobles, have foreign teachers, males and females, in their families, as Germans, French, Italians, English, &c. but it is rather unfortunate, that a vast number of these instructors have been formerly employed in the lower capacities of life, while but a few of them have received a good and polite education. Of course, though the pupils may acquire a facility in speaking languages, they seldom have the best models of manners, of character, or of learning, for imitation.

The public education of the Russian nobles is at the *pensions*, or boarding-schools, of which some are under the patronage of the crown or of the universities, while the greater part are conducted by private individuals. Most of the public seminaries have a magnificent and imposing appearance, and their *syllabuses* convey exalted ideas of their utility, which are rarely realised. Dr. Lyall has given a minute account of some of them, as well as of the universities, and of the general course of instruction, to which we refer the curious reader. We may briefly state, that the plans of instruction seem excellent on paper, and, with a few changes dictated by necessity, are such as might be adopted for the education of youth in any country. The greatest part of the private boarding-schools are liable to the same objections as the public ones, few of them being ably and well conducted. Scarcely any of the nobles enter the universities, on account of a foolish idea, that such institutions are only the sanctuaries of education for those who are afterwards, in some way or other, to gain their bread by their talents or learning. This is too *plebeian* an association, therefore, for a Russian *nobleman* to be connected with. A few of the better instructed and more liberal minded individuals notwithstanding attend the public lectures of the professors, and no doubt in time this practice will become general.

ARCHITECTURE.

Architecture.

Dr. Lyall's quarto contains an essay on the origin and progress of architecture in Russia, from which we shall select a few general remarks, especially as the study of the science has been of late so much cultivated by the learned in our island. This author treats in succession of, 1st, The style of *primitive architecture*, (if worthy of the name,) shown in the construction of the wooden houses of the Russians, before the taste and ornaments of Greece were known; or at least were adopted for their embellishment. 2d, The style of *civil architecture*, which has prevailed since the introduction of Christianity, arts, and sciences into Russia. 3d, The style of *ecclesiastical*, or *sacred architecture*, from the same era.

Rude architecture.

1. *Rude Architecture.*—The first style of architecture, or rather of building, in Russia, is the most sim-

ple in the world, and what even savage life might have dictated in a cold climate, though probably it marked the dawning of the Russian from the deepest barbarism. The houses of the peasants may have had their origin in square huts, the pieces of which were loosely joined together, which experience and practice, and consequent improvement, may have brought to the state in which they are in the nineteenth century. Nothing can be more simple, even in our days. Round baulks are laid one upon another, and morticed together at the various angles, and, after a little adjusting, the interstices are crammed with moss and junk. Such structures require no talent beyond that of imitation. The wood of the forest, the moss of the field, and the clay of the earth, are all the materials the peasant requires, and with these he is almost every where surrounded. A few simple instruments, to give figure to the separate parts of his dwelling, were probably his most early inventions. A square, one of the simplest figures to erect, is the form of his habitation. Experience taught him, that the roof must be acclivitous to carry off rain. Common sense told him, that apertures must be left for the admission of light. The floor served as his hearth, on which he kindled his wood fire; but being incommoded by the smoke, he was obliged either to have his door open, or to make an aperture for its exit.

As soon as the Russian savage had emerged from the deepest barbarism, he began to think of order, comfort, and convenience, and his efforts were naturally turned to architecture. In time ovens and chimnies were introduced, and his instruments were improved by intercourse with other nations. The present dwelling of the Russian peasant is nearly square, formed by substantial wooden walls, with a few small apertures or windows, the floor of which is covered with planks, and contains an oven for warming his abode and cooking his victuals, the top of which being flat, also serves as his bed. If his family is large, however, a *palâtka*, or a number of boards joined together, like a great shelf, is erected near the roof for part of them. A bench surrounding three sides of the square, and fixed to the walls, a small table, and a few earthen and wooden dishes, and iron utensils, are all his furniture. The meaner houses have no chimnies, and the smoke passes out at an aperture made through the wall. The better houses have windows, and are covered with planks; the poorer houses have apertures in place of windows, and are covered with straw.

Civil architecture.

2. *Civil Architecture.*—The native historians give us but little information with respect to the progress of architecture. But as the Russians decidedly received their ecclesiastical architecture from the Greeks, it seems but natural to conclude that they also received their civil architecture, though no monuments of the tenth, eleventh, or twelfth centuries remain to enable us to form a correct opinion. It has also been conjectured, that the Russians might have borrowed their form and fashion of architecture from the Tartars; but it may well be doubted, whether at their invasion of Russia in the thirteenth century, the Tartar nations possessed any knowledge of architectural decoration. Scarcely a vestige of any thing of the Chinese style now remains at Moscow, though perhaps the specimens were more numerous in later times.

The beautiful Gothic style has never been prevalent in Russia. But few traces of it are to be seen in Moscow of a date older than twenty years; and there is not a single fine building in this style in St. Petersburgh.

Towards the end of the fifteenth century, and during the reign of Iván Vassielievitch, Italian artists, engineers, cannon founders, goldsmiths, and masons, were drawn to Moscow, by the hope of great recompense, and no doubt contributed much to the improvement of architecture in general, besides building cathedrals and churches, and the walls of the Kremle. From this time up to the accession of Peter the Great, the Greeko-Italian architecture most probably continued to make considerable advancement. In the reign of Peter the Great, both civil and ecclesiastical architecture were extraordinarily improved by the building of Petersburgh, and from that capital no doubt many improvements were carried over the empire. The empress Catharine the Second was a liberal patroness of the arts, sciences, and literature. Even the *destroying* Paul erected a few buildings, and the reign of the present sovereign has already been prolific of elegant and magnificent edifices.

For many years past, both of the capitals have been well supplied with the most able Italian architects, and they were and are to be found even in some of the government and principal towns of the empire. The numerous models they have given of elegant taste and style, have drawn forth the eulogies of travellers, especially in the capitals, two of the noblest cities in the universe.

The Greeko-Italian style must at first, in some degree, have been modified by the climate of Russia. But the architects, having acquired a knowledge of counteracting severe cold, by extremely thick walls and excellent stoves, were left to the free exercise of taste, as in the more genial clime of Italy. In these days, the interior of the mansions of the nobles is so arranged that the visitor might conceive himself at Rome.

3. *The Ecclesiastical Style of Architecture.*—Ecclesiastical architecture is the most ancient of which any vestiges remain, and is the most distinct and pure of any thing that has become national. To have an idea of the primitive style of sacred edifices in Russia, it is necessary to allude to those of the ancient capitals of the former principalities of this empire, Kiéf, Novgórod, Vladimir, Tver, and Moscow. From all that Dr. Lyall says in his minute account of these edifices, it is evident that the Greek style of ecclesiastical architecture, modified and ornamented afterwards by the Italians, has ever prevailed, and still prevails in Russia. A few exceptions of edifices, which are not reduceable to any known style, cannot effect this general conclusion. One ornament, which is almost universal, of the Russian churches, has excited the attention and curiosity of all travellers. We allude to their *bulbous domes*, or domes of the shape of an onion. As no such shaped domes have been discovered in the churches in Greece, it has been agitated whether they were not a national ornament. After a long discussion of this subject, Dr. Lyall concludes, that as bulbous domes were used in Syria and Palestine above a hundred years ago, it is probable that they may also have been adopted there long before that period, and that Russia may have received them through this channel. He is so far from regarding them as a national ornament, that he even questions whether they have been used in Russia for above 300 years. He thinks the bulbous domes decidedly came from the east, where they are very common ornaments at present, and is of opinion that their

pagan derivation is extremely plausible. The Egyptians worshipped onions, and perhaps the same practice may have been common among others of the oriental nations; and as it is natural to elevate any object to which reverence or adoration is paid, it is probable that onions, and these onion-shaped bodies, may have been placed upon low pillars to receive homage, and afterwards were continued merely as ornaments, in consequence of their agreeable figure, and their adaptation as the summits of towers; and from thence became the embellishment of sacred temples.

CHARACTER OF THE RUSSIANS.

The widely conflicting accounts of our own countrymen, as well as of continental writers, have for a long time placed us in a dilemma with respect to the character of the Russians. The picture is altogether different in the works of Coxe, Tooke, Clarke, Porter, and Wilson. After a perusal of the volumes of these authors, we are lost between the excesses of exaggerating praise and sweeping condemnation. A late author, Dr. Lyall, whose long residence in Russia, and whose intimate connection with, and knowledge of, all the classes of the population of this country, as well as with the native language, gave peculiar advantages over preceding English writers, has endeavoured to account for these discrepancies, and to portray the character of the Russians in a true light, and with all its shades. He professes to have formed his opinions from facts, and to have stated the convictions of his heart with impartiality, and wishes, if any bias be discovered, that it may rather be on the side of benevolence than on that of malice. He informs us, that some travellers seem to have thought it a necessary part of their duty to traduce and calumniate the Russians, so as to be in the fashion; while others appear to have gone into the other extreme of lauding and flattering them for the sake of contradiction. These, combined with other causes, especially ignorance, limited observation and prejudice, will account for the wide difference of authors' opinions as to the national character of the Russians. It is assuredly unfair to make a comparison between the natives of Russia and those of other European nations, which have been civilized and polished for many centuries; and yet that such a comparison has generally governed the minds of most foreigners, is evident from an impartial perusal of their works.

No man in his senses would ever pretend that Russia is as civilized and polished as France, Germany, Britain, or some of the other states of Europe; but yet it must be allowed, that in this country civilization and literature, arts and sciences, military and naval tactics, have made in the last century, and are still making, extraordinary advances. Russia must be compared with *Russia* herself at various epochs, and must be viewed through all her gradations and ramifications, in order to ascertain her progress in the intellectual world.

In treating of the national character of the Russians, we shall speak separately of the nobility, of the clergy, of the merchants, and of the peasantry, though many of the remarks may properly be applied to all these classes.

1st, *The Nobility.*—"The higher class of nobility, those who give the ton to society, and those who have travelled," says Lyall, "may be regarded as equally civilized, in so far as regards their conduct and manners, though generally not so learned as individuals of corresponding rank in the other nations of Europe. The lower nobility, and especially the untravelled, retain more of the national customs and manners, and exhibit more decidedly the distinguishing characteristics."

The despotic nature of the government, the excessive military taste, and the puerile distinctions of ranks, naturally render the natives of all classes of society servile and obsequious, diffident, and even cowardly to superiors; haughty, commanding, and frequently severe to inferiors; and insensibly lead the attention more to the exterior of the man,—his uniform and his ribbands, his stars and his crosses, than to his religious or his moral conduct, his literary attainments, or his place in the intellectual world. The same causes explain the neglect of inferiors, and even at times of equals: when a noble of a higher rank makes his appearance unexpectedly in the circle of a family party, the harmony and sociability of which are destroyed, by the general and long protracted attention and deference paid to the visitor. To this, however, there are honourable exceptions; there are spirits which breathe liberality and independence, and minds too great to accept the proffered honours, or assume airs of *hauteur*, in consequence of vain and factitious distinctions. Equals in rank are affable and polite, obliging and social; and perhaps in no country in the world do acquaintances, friends, and relations, mingle with less restraint, or *from habit* use more warm and endearing expressions to each other than in Russia. The difference between lord and vassal allows a familiarity which no other state of society could admit; a look, a gesture, or a word from the former having a magic effect upon the latter. Dr. Lyall, however, relates that as far as his experience goes, he cannot say that the nobles are *generally* cruel or oppressive to their slaves. This author says, "The Russians are insinuating and cunning, deceitful and perfidious, sensual and immoral, given to levity, fond of novelty, and improvident; with the command of little money they are avaricious and mean; when cash abounds they are generous, ostentatious, and prodigal; they are cheerful, good humoured, and social; they are luxurious, hospitable, and charitable; they love light occupations and amusements, as plays, operas, masquerades, exhibitions, dancing, singing, and instrumental music, chess, draughts, and billiards; but above all, playing at cards, to which whole days, and weeks, and months, and years are devoted. They have a great curiosity to pry into the affairs of others; they have quick apprehensions; their talent for imitation is universally allowed; they are fluent in languages; a few are endowed with good parts and ingenuity, and are men of literature; the generality are moderately well informed and accomplished, *as to what regards the exterior of life*; few are distinguished for their proficiency in the sciences; they are accustomed to good living, but are generally moderate in their cups; they are disposed to indolence, to a sedentary mode of life, and to much sleep. They are too little in the habit of taking bodily exercise; and yet when urged by affairs or necessity, they are excessively active, and withstand extraordinary hardships and fatigue. The manners of the higher and travelled nobility are easy, elegant, and imposing; and the natives of no country can make themselves more agreeable to foreigners. The manners of the lower nobility are affected, consequential, overbearing, and sometimes rude; though some few of them are endowed with amiable and generous passions. From a certain complaisance and politeness of manner, the Russians make the fairest promises, and the most flattering assurances, when nothing more is intended. Being uttered without meaning or sincerity, you can have no reliance upon them. Having gained the object of the moment, which, perhaps, was to make a favourable impression, they think no more of the matter, and laugh at you for having been so easily duped.

Russia is the empire of extremes and contrasts, whether we regard the face of the country, its climate, and productions, the diversity of its inhabitants, or merely the national character of the *real Russians*. A Briton requires to be only a very short time among this people to enable him to remark, that all ranks are most ardent in their expressions of friendship, but that the constancy of their attachment is not equal to the fervency of their emotions. They have more sensibility than firmness; they have lively feelings; but having seldom employed their reason in forming general rules of conduct for the commerce of life, their actions, as flowing from various and shifting emotions, are desultory, and even inconsistent. The terms and phrases of endearment among them are as extravagant as they are gross and violent in their abuse. They are really bearded children; the creatures of the present hour; they will express the most ardent affection in the most ardent language; they will express the most furious rage, in the most vindictive terms. But as we need not lay great stress on the advantages to be reaped from their friendship, so we need not be greatly afraid of their inveterate or latent enmity. They go from one extreme to another, and they think that all the world can do so likewise. They quarrel with you, and treat you ignominiously, and expect that you are to take no notice of the matter whenever they change their mode of procedure. Though nothing can be more characteristic of the Russians than double dealing, yet it is to be hoped that their inconstancy, their deviations from truth, and even the perfidy with which they are sometimes charged, may not be so much the effect, of determined vice, as of irregular feelings. Dr. Lyall's opinion is not favourable in this respect. "It must be avowed, and it is a lamentable avowal," says he, "that the Russians are not a sincere people; and *that not one in a hundred has any friendship worth preserving*. Warm hearts are deceived by their ardent professions. The inexperienced think they have friends; but sooner or later they discover their mistake, and sometimes pay dearly for their ignorance." It has been aptly enough remarked, that the Russian nobles build houses for giants. All their undertakings are upon the great scale, and they are seldom completely executed. They are pushed on with vigour till novelty becomes exhausted, or till pecuniary means fail; they are often interrupted, sometimes recommenced, but rarely receive the last, the finishing touch. There are, however, exceptions to this general feature, but not numerous: for Dr. Lyall says, he could not point out half a dozen *completely well arranged and furnished* nobleman's establishments, among the hundreds of sumptuous palaces, the numerous fine villas, and the many beautiful country retreats which decorate Moscow and its vicinity.

Though some of the nobles are cleanly in their persons, and have their mansions well furnished and arranged, it must be allowed that, generally speaking, there is, in these respects, much room for improvement, and no where so conspicuously as in the Russian kitchens. A Briton, accustomed to all the neatness, order, and regularity of his dwelling in his own country, and especially to his cool, quiet, and comfortable bed-room, is particularly sensible of the change he experiences in Russia, where the whole system of life is so opposite.

The genius of the Russo-Greek religion tends to render its votaries superstitious and bigotted, to supplant the calm and sincere devotion of the soul, by attention to pompous ceremonies, splendid dresses, and the glare of burning candles, to smoking censers, sonorous speeches, and solemn music, and to substitute crossings and prostrations, salutations, and undue reverence to the holy images, for serene and holy meditation on the supreme being: in a word, it has all the outward show of ornament, but too little of the practical and indwelling influence of virtuous and religious conviction. It warms the passions, excites the feelings, and captivates the imagination; but, alas! it has but too little effect on the moral conduct of its adherents. There are, no doubt, characters of this persuasion, whose principles and conduct coincide, and do honour to our race, and whose morals and religion are of the purest stamp; but unfortunately their number is small. Even this, however, is consolatory to the bosom of the Christian.

In one respect the Russians deserve the highest praise. They long have shown, and still show, an example worthy the imitation of nations much more remote from the age of ignorance and barbarism, in their toleration of all religions and of all sects. Were this toleration merely enforced by an ukáz of a despotic government, as it may have been in its origin, it would be no characteristic of Russia; but when in a young nation, charity in religious belief is prevalent among all ranks and gradations of society, from the sovereign to the peasant, the admiration and gratitude of all must be excited: and foreigners resident in that country feel themselves in possession of a great blessing.

We shall now descend to a few particulars. The talent of imitation of the Russians has been dwelt upon by many authors. Dr. Clarke speaks of this subject in the following terms: "Imitation is the acmé of Russian intellect, the principle of all their operations. They have nothing of their own; but it is not their fault if they have not every thing which others invent. Their *surprising powers of imitation exceed* all that has been hitherto known." To the accuracy of this quotation, Dr. Lyall remarks, general assent must be yielded; but he adds, it must not be forgotten, that Russia has produced ingenious historians, and meritorious poets, who, while they have borrowed much from the other nations of Europe, have also, now and then, exhibited original ideas and talents; and a few of them have written well in French. In our days, Russia also can boast of one original and great painter, whose name is now pretty generally known by the dissemination of his works. This is the distinguished Orlóvskii, who is attached to the Imperial Court, and who has most successfully illustrated the customs and manners of the Russians by his admirable pencil. The engravings from these, which were tolerably well executed in Russia, have since been copied and finished in a superior style, both in Germany and in France, as well as in Britain. With respect to the talent of imitation, reckoned so peculiarly striking of the Russians, we have our own opinion. Imitation ever has been, and ever must be, one of the most remarkable talents of savage life, or rather of savages in their gradual transition from barbarism to civilization; and in proportion as they recede from their rude state and approach the refinements of civilized society, so much more astonishing will their imitative faculty appear, till on its full development it be appropriated, and assume the new name of skill, expertness or genius. The savage becomes an enlightened man, and the sources of his information and of his imitation are forgotten in the long lapse of time, at least of several ages, of this progress of a nation from barbarism to civilization. By this reasoning, the imitation of the Russians is easily explained, without any thing marvellous. Russia is crowded with foreigners from all countries of the earth, and especially with mechanics, artists, players, dancers, singers, instrumental performers, &c. &c. Of course the Russian peasants, especially tradesmen, and the slaves of the nobles, who compose part of their magnificent establishment, have an opportunity of seeing and of imitating them.

Now this is exactly what takes place. But as Russia is the only uncivilized nation which most travellers from Europe have visited, so, of course, it has become the peculiar object of their notice, and of their laud, simply because they had no means of contrast. We doubt not that a traveller, who had visited different savage countries *ceteris paribus*, would say, that in all of them the talent of imitation was equally manifested. Indeed we are rather surprised that Dr. Lyall should have missed such an explanation. He tells us, that the much vaunted talent for the acquisition of languages, said to be characteristic of the Russians, is easily explained by the advantages of their having foreign tutors from their youth, without supposing any universal or miraculous talent.

It has even been supposed by some, that the word honesty was not contained in the Russian language; but Dr. Lyall assures us, that this is a great mistake, and that it is continually reiterated by the natives, and often for the worst of purposes. The name, however, is generally substituted for the reality; but at the same time it is admitted, that there are a few Russians of the strictest probity, rectitude, and honour. Some authors have reported, that as the Russians at death could easily find a passport to heaven, their moral conduct was of little consequence; but unfortunately for their veracity, this passport, of which Dr. Lyall has given a *fac-simile*, is neither more nor less than a printed absolution-prayer.

The curiosity of the Russians of all ranks to pry into the affairs of others, exceeds all belief. With the greatest ease, the nobles ask the most impertinent questions with respect to a person's connections and family, his property and revenues, and his secret affairs and private opinions. Evasive answers, so far from silencing them, only prompt farther their curiosity, and they continue to tease him with their demands in all forms, either till he lose patience, and show symptoms of displeasure, or till they extract some intelligence from him. Nay, so singular are they, that they evidently show hurt feelings at his refusal to gratify their inquisitiveness, especially if he be in the smallest degree dependent upon them. They are not contented with making inquiries merely of himself; they apply to his servant women, or his servant men, to his lackey, or his coachman, or to any body who may be able to give them information. If he is living in one of their families, the master or mistress generally is acquainted with every thing he does, through inquiries made at his servants.

Manners and customs.

Almost all writers have loudly complained of the dirtiness of the Russians, and some have supposed it equally characteristic of the noble and the peasant, of the palace and the cottage. Clarke gives a degrading and revolting account of the Russian noblemen, which Lyall reckons a complete caricature. But this author himself relates many histories and anecdotes, which go far toward the confirmation of some of Clarke's opinions, and seem at times at variance with his own. The public, however, seem now pretty much convinced of the general exaggeration of all Clarke's statements, favourable or unfavourable about the Russians. "The Doctor," says Lyall, "must have met with some of the nobles of Russia who were very cleanly in their persons, and not only elegant, but even exaggerated in their dress, and who were far elevated above the 'rank of brutes,' or of 'two-legged pigs." Nevertheless, Lyall admits, that in penetrating into some of the private apartments of the nobles, late in the evening, or early in the morning, scenes of confusion are seen which excite the highest astonishment, and many of his relations tally with this statement.

Vermin are abundant in Russia, especially among the peasantry. Many of the nobles are also surcharged with them, and even some of the ladies are not free of *corporeal and cranial* insects, and of course require to use the close-teethed comb. At the same time, it must be admitted that a few are cleanly in their persons. The warmth of the Russian houses, in consequence of the universal use of stoves, and of coverings of different kinds of fur, even within doors, partly account for the abundance of a variety of vermin, while their filthy manners must explain the origin and propagation of the rest.

It was formerly a general practice for individuals of all ranks, and at the first tables, to retain the same knives and forks during dinner, at the conclusion of each dish, cleaning them upon a piece of bread, or sometimes without this ceremony, laying them down upon the table-cloth. The same indecorous custom still prevails, except in the houses of the more polished nobles, where the knives and forks when put down upon the plate, are taken away and replaced by others; but among the lower classes, when left upon the plate, they are taken away, wiped and returned, so that the same knives and forks are used for a variety of dishes; for fish, flesh, and fowl. At a Russian table every one pleases himself, so that it not unfrequently happens, that one half of a party have their knives and forks changed, while the other half retain theirs from the commencement to the conclusion of the repast. In some houses, little low silver stands are placed upon the table, one for each guest, on purpose to lay the knives and forks upon when not immediately requisite. It is not very uncommon, Clarke says, for the Russian servants, before your eyes, to spit upon the plates, and wipe them with a dirty napkin, or a more filthy towel. Another abominable usage is common in the houses of all the princes and all the nobles of the empire. The servant men are so numerous, that very often there is one for each guest, besides those who serve up the dishes; so that not unfrequently we see tens, and even twenties of them arranged in rows behind the chairs of the company, each with a plate under his left arm, or rather in his arm-pit, which is by this means warmed and perfumed by the time the guest he waits upon is ready to receive it.

Akin to the above is the following custom: At the

Manners and customs.

first tables, jellies, marmalades, and preserved fruits, are generally served up as a part of the dessert, and every guest has his own plate; but sometimes it happens that the same spoon makes the round of the table with the preserves or jelly, and serves the whole company. Each individual having filled his mouth, kindly passes the spoon for the accommodation of his neighbour. Among the lower nobility, the ladies and gentlemen having retired from dinner, often find fruits and jellies placed upon a covered table, to which they approach, and help themselves at their pleasure, one spoon serving all the party, however numerous. This practice is carried to the most disgusting degree among the rich merchants, among the clergy, and among those peasants who have acquired wealth by their industry or their good fortune.

Another extremely disagreeable practice, spitting upon the floor, is prevalent among all classes of the Russian nobility. Neither fine inlaid floors, nor even Wilton carpets oppose any obstacle to this filthy custom. The Russian noble will spit immediately before you, and rub the saliva with his foot. He sometimes, however, retires to a corner to conceal this deposit.

Picking the teeth with a fork during meals, is a general and most offensive custom, which can never be sufficiently reprehended, were it only on account of the danger which attends it; and the same remarks are equally applicable to picking or cleaning the ears.

In the streets of Petersburgh and Moscow, as well as in the villages of the empire, lazy loungers, and in the shops of grocers, butchers, &c. their attendants are frequently seen in the act of searching each other's heads for vermin; but those of the nobility who require the same attention do not expose themselves so openly as has been said. The Russian peasants, when they visit the bath, which is generally at least once every week, often wash their shirts at the same time, especially when they have no change of linen. Sometimes also, they hold their shirts and their shoobs or sheep-skin pelisses over a hot stove, till the vermin fall off. But they have another and most effectual way of destroying such pests when they become superabundant. In their own language, they *roast their clothes*, i. e. they strip themselves, and having loosely rolled up their vestments, they introduce them into the hot oven of the bath, and they allow them to remain there until they conjecture that no more victims remain for sacrifice. Another very extraordinary practice is prevalent among the peasantry, in those poor villages which have no *banyas*, or baths. In Russia, all the peasants houses have stoves, like bakers ovens, with flat roofs, in which they not only bake their bread, but also daily cook their victuals. On Saturday evening, these ovens are made to serve the place of baths. Being duly warmed, water is thrown into them, and abundance of vapour is instantly produced. The peasants, one by one, creep into the interior of the oven, and having steamed themselves, they use ablutions with cold and hot water, as at the ordinary *banya*.

The Russian peasantry, during winter, generally sleep on the flat and warm tops of their ovens; they are not averse to enter, or at least half enter them, and being excessively fond of heat, Dr. Lyall relates that a woman servant attached to his family was missing in an extremely cold evening, and that after a long and anxious research, she was discovered, in a profound sleep, nearly within the kitchen oven.

The horrors of the Russian kitchens are inconceivable. The interior of but few of them could be viewed without the appetite being appalled or destroyed.

There are but few beds in the whole Russian empire, which an Englishman, aware of its condition, would venture to approach. It is astonishing that the Russians should not pay more attention to fine bed-rooms and elegant beds, for daily convenience, and not for mere exhibition, especially as most of the articles requisite for the purpose are low priced in their country. Few rooms altogether fitted up and furnished like bedrooms, as in Britain, are to be found in the northern empire. They form a luxury which the Russian knows nothing of, except what he has learned in foreign countries, heard of from travellers, or read of in books. The Russians assuredly have plenty of *spalni*, or bed-rooms, as they call them, which are open to the whole house, and often form one of a suite of rooms in small houses. In the palaces and mansions of the nobles, there are elegant rooms, containing state-beds, in which no person reposes. They are generally left open, and as they make part of a suite of chambers, may be reckoned part of a nobleman's *parade* or *show rooms*.

The Russian nobility, when they attend the festivals of their neighbours, generally carry their beds with them. Hence on the day before a fête, numerous carriages, filled with nobles, arrive from time to time, some of them with large bags filled with beds, and fixed behind them; others followed by *telégas*, or small four-wheeled carts, loaded with beds and pillows. After supper, and the conclusion of the amusement of the day, cards, &c. a scene of bustle and confusion follows, which seems extremely curious and ridiculous. The dining-room, the drawing-room, the hall, and the whole suite of apartments, in which the evening has been passed, are converted into bed-rooms. Dozens of small painted and unpainted bedsteads, each for a single person, and of the value of five roubles, are speedily transported into the chambers, and arranged along the sides of the rooms, which soon resemble a barrack, or the wards of an hospital. Scores of servants belonging to the host and to the visitors, are seen running backwards and forwards, with beds and mattresses, pillows and linen, *shoobs* and baggage. Many of these beds have no inviting appearance. Others of the guests, who have been less provident than their neighbours, are accommodated with beds from the master of the house, and when a scarcity occurs, the beds of his servants are put in requisition. It also happens frequently that the number of bedsteads is insufficient, but this is of little moment. In this case, the beds are arranged upon the floor, upon chairs, and upon the *lejánkas*, or flat parts of some of the stoves. Besides all the sofas and divans are at once converted into places of repose for the night. Dr. Lyall has drawn a description of such a scene at a grand fête given by a nobleman. He made a visit to one of the houses adjoining to the proprietor's mansion, in which a number of his acquaintances were lodged. He found the hall and the drawing-room literally a barrack. Sofas, divans, and chairs put together, covered with beds, and their fatigued or lazy tenants formed the scenery of the first apartment; in the latter was arranged a *sleeping-place* upon the floor, for half a dozen noblemen, with beds, pillows, *shoobs*, great coats, &c. The possessors of this den, wrapped up in splendid silk night-gowns, some lying down, some sitting up in bed, some drinking coffee and tea, and smoking tobacco, amidst mephitic air, and surrounded by chamber utensils, and other disagreeable trumpery, formed a curious motley association.

Another and a curious nightly scene takes place in the palaces of the nobles of Petersburgh and Moscow, as well as in those of the interior of the empire. The enormous number of servants attached to the establishment of the grandees, has excited the surprise of all European travellers; but few of them, perhaps, enquired, or had an opportunity of knowing, how these servants are disposed of when the evening parties break up. So many of them retire to the wings and the other numerous edifices, which are always the concomitants of a princely fortune in this country; and those who are inmates of the master's dwelling occupy the lower story and the back rooms, and there they sleep; the rest make their beds upon the floors of the anti-chambers, and even, at times, within the rooms. Thus the whole range of the back apartments of a large house or palace is every night covered with beds laid upon the floor, and a crowd of human beings huddled together, under sheep-skins, *shoobs*, great coats, bed-covers, or whatever comes most readily to hand; so that while the walls of the elegant suite of apartments in the front are covered with paintings, the floors of that in the back are covered with human beings, like so many dogs. The bad air, and the filth of such a den, on the following morning are indescribable; and the numerous kinds of vermin which have revelled the whole night, can only bear allusion. In the morning, all hands are called to work, to remove the beds and other *accoutrements*, and clear the floors for a few hours, when the same scene is repeated.

Let us now turn to the virtues of the Russians. Considerable apparent diversity of opinion has existed with respect to the hospitality of the Russians. Dr. Clarke not only spoke of their hospitality, but also of their "*prodigious hospitality*," but at the same time he assigned such motives for its practice, as rendered it altogether a nugatory virtue in the north. From the concurring testimony of writers and travellers, it may, however, be concluded that the Russians are an *hospitable people*, and that no where in the autocratic dominions is that virtue carried to a greater height, than in the icy regions of Siberia. Russian hospitality is not confined to civil life, but extends throughout the army and the navy. "Wherever," says Dr. Lyall, "I have met the Russians, whether in warm or frigid latitudes, hospitality made a strong feature of their character, and was so natural to them, that they practised it apparently without knowing it to be a virtue, or that it merited applause."

Every Briton who has not travelled much upon the continent, or in other parts of the world, or who is transported at once from his own country,—characterised by foreigners for punctilio and stiffness,—to the ease and freedom of Russian society, must be equally astonished and delighted with the invitations to the open tables of the nobles, and the hospitable manner in which he is generally treated without any ceremony. As the Russians seem to acquire new life in having a numerous retinue at their repasts and their fêtes, it is true, a motley crew both of males and females, of all ranks, and character, and appearance, are associated together; an association often the most incongruous and the most disgusting to British feeling. There is much truth in what Dr. Clarke says upon this subject, though written in lively and strong language. "A swarm of slaves, attendants, hirelings, and dependant sycophants," says he, "is peculiarly characteristic of domestic economy in Moscow," and he might have added, throughout the Russian empire. "The nobles consider the honour of their families so materially implicated in maintaining a numerous table, that should any of the satellites which usually surround them, forsake his post at dinner, and swell the train of any other person, the offence is rarely forgiven; they will afterwards persecute the deserter by every means of revenge within their power; and, not being burdened by scruples of conscience, they generally find means of indulging their vengeance. I have seen persons who were victims of their own good nature, in having accepted invitations which decoyed them from the table of their lord. Similar motives gave rise to the prodigious hospitality which has been described by travellers. Before the reign of Paul, a stranger no sooner arrived in Moscow, than the most earnest solicitations were made for his regular attendance at the table of this or that nobleman. If his visits were indiscriminate, jealousy and quarrels were the inevitable consequence. During the reign of Paul, Englishmen were guests who might involve the host in difficulty and danger; yet notwithstanding the risk incurred, it is but justice to acknowledge the nobles felt themselves so gratified by the presence of a stranger, that having requested his attendance, they would close their portals upon his equipage, lest it should be discovered by the officers of police." Ever since the present sovereign held the sceptre, however, no such restraints have been known, and strangers have been openly and kindly received and treated by all ranks with whom they could associate. As in other countries, especially in the capitals, hospitality sometimes resolves itself into mere state and show, and the exhibition of the master's superiority and vanity;—in short, into mere ostentation. But this virtue is so general among the Russians that it has been reckoned a remnant of barbarism, because it generally prevails among savage and uncivilized nations and tribes. Whatever be its origin, it is a virtue which reflects the highest honour upon the natives of Russia; and the more so, that in their country some of the other social ties of civilized society, especially those of friendship, are so unsteady and so feeble. Many of the imperfections of Russia are, no doubt, those of an early period of civilization; and they, even in some points, remind us of the barbarous days and the feudal times of Great Britain. At present,—though less so than in times already gone by,—the cheapness of provisions, or rather the stores in kind, which almost every nobleman has, renders it a very easy affair for him to make large entertainments without spending almost any money, except for wines and luxuries; and his possession of vassals enables him to employ a great many servants in all different capacities, without almost any decrease of his revenues. In consequence of these facilities, many of the nobles fit up private theatres, at which their own servants are the actors; so that tailors and shoemakers, musicians and dancers, body-servants and lackeys, sempstresses and chambermaids, &c. during day, in the evening become kings and queens, lords and ladies, &c. But the advance in the price of provisions which has followed, and promises to follow the footsteps of civilization, has already narrowed, and will gradually narrow still more the sphere of hospitality, and Russia in

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time will come to be upon a par in regard to this virtue, with the other nations of the continent. The losses sustained by the burning of Moscow, in 1812, the increased price of provisions in the capitals, and in most of the large towns, the excessive depreciation of the currency, and the example of simplicity and regularity in the mode of life set by the monarch, Alexander, have especially tended to change the style of living of late years. Carriages with six horses, which were once very common, are now rarely to be seen; the number of carriages with four horses, though general, is greatly diminished; and princes and generals now frequently ride and visit with a *droshki* and pair of horses. Daily open tables are less common, and indeed exterior display is gradually giving way to the real comforts of life. But the number of hospitable mansions is still so great, that travellers who are well recommended will be unable to perceive any change, unless they have been in Russia at some anterior period. The resident in Moscow, nevertheless, can indicate many nobles who formerly lived in an oriental style of magnificence, and who now can scarcely support their rank, some who have withdrawn themselves into obscurity, and others who are reduced to comparative poverty.

A late author, whom we have often had occasion to quote, thinks that charity is a prevailing virtue among all classes of society in Russia, although he at the same time admits that there are exceptions to this statement, and even instances of the height of selfishness and avarice. The charity of the Russian nobles, and even of the richer merchants, is demonstrated in various ways, as in the institution of hospitals and infirmaries, the protection of widows and orphans, the assistance of the poor, the subscription to humane societies, the relief of prisoners, &c. Even the erection of churches at times seems to have been the offspring of this virtue. Superstition, and the hope, nay the belief, however, of a positive and immortal reward, have raised more temples to the Lord in Russia, as elsewhere, than genuine love to human kind. In late times the erection of some charitable institutions, as hospitals, has frequently been the bartering price of an order of knighthood, or of some immunity or privilege.

Mendicity is not so common in Russia as in free countries, because in case of poverty, or incapacity to work, the proprietors are obliged to maintain their slaves, and the boors of the crown are equally protected. But notwithstanding the laws, it happens, at times, that the slaves of some of the poorer or more avaricious nobles, are necessitated to have recourse to beggary for existence. Others are reduced to the same state, by improper conduct, or in consequence of their villages being burned, a very common occurrence in the greater part of the Russian dominions, owing to their being constructed of wood, and to the carelessness of the peasants with their *lutchinkas*, or burning pieces of lathe-wood, which serve in place of candles. It is not common for Russians of any rank to let mendicants depart from their door without giving them something, though it be only a morsel of black bread.

In no instance is the charity of the Russians more conspicuous than in their kindness to orphans, whether the children of natives or foreigners. If a foreigner die and leave a young and unprotected family behind him, there is no difficulty in getting them disposed of. One or two of the children may be placed in one nobleman's family, and as many in another. They are often treated as their own family, and even sometimes adopted by those who have no offspring; and by those who have, they are reckoned their children's companions, and generally receive the same domestic education. No doubt, at times, the nobles make their own calculations in these arrangements. They wish to have companions, on purpose to play with and amuse their children, and when they speak a foreign language, to be useful in accustoming them to speak it, while they receive lessons from their tutors. But it would be the height of injustice to suppose that such acts are never done without some self-interest,—some sinister motive.

The Russian nobles do not drink ardent spirits, *vodki*, in the morning, as has been represented by some. The custom in Russia is to take tea and coffee at a pretty early hour, and generally without either bread or sweet cake. The Russian *závtrak*, or breakfast follows at ten, eleven, or twelve o'clock. It is the *frühstück* of the Germans; the *dejeuner à la fourchette* of the French, and neither an English nor a Scotch breakfast; but, in general, it might pass for a good dinner. It commences with a dram (schall), pickled herrings, caviar, &c.: steakes, cutlets, a fricassée, fowls, and pickles, boiled eggs, roasted potatoes, pastry, wine, and porter, all or in part generally follow; but a ceremonious *závtrak* is in fact a neat and elegant dinner. The Russian dinners and suppers generally consist of a number of good dishes, in which a mixture of German and French cookery prevails, besides some others, which are almost peculiar to Russia, as *stchi*, or sour cabbage-soup, salted cucumbers, *klukva*, and *kvass*, two agreeable drinks, the first made from the cranberry (*Vaccinium oxyccocos*), and the latter by fermenting rye. The attention paid to eating and drinking and cookery, is made a very serious affair of in Russia, as well as in some other countries. Almost all the higher nobility either have had foreigners to teach their slaves the art of cookery, or still retain them, in order to satisfy their delicate and fastidious palates. Others have sent their vassals to the imperial kitchen, or to the tuition of some distinguished cook in the capitals, in order to be taught so important an art. In some of the larger establishments of the nobles at Moscow, four, six, eight, and even above ten men-cooks are employed, besides half a dozen, a dozen, or a score of assistants in the kitchen; and it is rare that even the poorest and the meanest noble is without a man-cook, even when living retired in the country. The cause of this is evident. A slave being once taught, costs his master little or no expence besides his maintenance and his clothes. In Russia women-cooks only get employment among the merchants, the clergy, and free people, and in foreign families.

The Russians certainly indulge themselves in eating too frequently and too abundantly; and the fair ladies no doubt destroy the beauty of the female form, by a want of discretion on this score. After partaking of a Russian *závtrak* before or at mid-day, a Briton is truly astonished at seeing the natives, even fair ladies, sitting down to dinner at three or four o'clock, with as voracious appetites as if they had been keeping Lent; if one may judge by the number of dishes which they share, and by the quantity of each with which they provide themselves. No wonder that most of the fair sex of the north remind us of the state of "those who love their lords." Such daily breakfasts, dinners, and suppers, besides tea and coffee, &c. combined with inactive lives, and assisted by the powers of Morpheus, all tend to destroy the symmetry of na-

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tase, to impair health, and to engender disease. The Russian nobles, if they do not merit the appellation of gluttons, may be said with much propriety to be great eaters.

The Russians are also great sleepers. They are generally early risers, but they almost universally take a *siesta* after dinner. Some, however, rise very late, and others pass half their life in slumber.

In more early ages, the Russians, high and low, were justly charged with the vice of habitual inebriety. About the middle of the fifteenth century, deep cellars, filled with strong mead, formed one of the chief manners of shewing prodigality, and there many a jovial party, as a quaint author says, used "to *drink drunke*" every day of the week. Towards the commencement of the seventeenth century, the ordinary drinks of the Russians were hydromel and spirits, and they never quitted the table without being sunk in drunkenness. The example and exertions of Peter the Great effected much toward the disappearance of inebriety among his nobles. The temperance of the present generation in the use of spirituous or intoxicating liquids is remarkable, and forms one of the most striking and best features in their character. Of late years the young nobles, and more particularly the young officers of the army, have become extremely fond of French wines, and are especially delighted with champagne; and sometimes at their parties, in the capitals and large towns, a number of bottles is emptied, which might justify the appellation to them of adherents of Bacchus.

The clergy and the peasantry form a striking contrast to the nobility, many of them being addicted to inebriation. The sale of *vino*, or common ardent spirits, is a grand source of revenue to the crown, and of disease and death to the population of Russia, which, in these respects, is not singular. The peasantry in the remote villages are generally more temperate, and some of them cannot be persuaded on any occasion to taste spirits. It sometimes happens, that even the physician cannot get a peasant to take a glass of toddy or negus when prescribed for his disease. He will repeat *Bojii volya*, God's will be done; "but come life, come death, I have never tasted *vino*, and now I will not commence and commit such a sin." But it is very common for the peasants to pretend to great sobriety, and to refuse spirits, in order to gain a good character, and to require pressing, when the fluid is swallowed with avidity.

The females among the nobles, although they take a cordial dram now and then, are also abstemious with respect to the use of spirits. Many of the lower merchants, and also their wives, are given to drunkenness. They consume great quantities of *yerapheitch*, a tincture of herbs made with the common *vino*, or ardent spirits. The wives of the Russian merchants, whose circumstances permit it, pass their lives in doing little else than ordering the preparation of food, eating and drinking, and repose and sleep. They do not work themselves; they take little or no charge of their children, whom they commit to the guidance of wet nurses immediately after birth; and as they are surrounded by servants, they contract the most indolent habits. A number of them very frequently meet together and make merry; and even when alone many of them get intoxicated. They then betake themselves to bed, which is often placed over a *lejánka*, or flat part of many ovens, and from the internal heat of spirits, and the external heat of stoves, their faces become excessively flushed. When a husband returns from his affairs, and finds his wife thus laid up, in a truly national manner, and while laughing, he addresses her in the mildest language, "What, my dear, thou art tipsy;" and she replies in the tone of disease, "No, I have the head-ache;" and no more is said about the matter.

Most of the more cultivated and richer merchants, who affect to follow the nobles in the magnificence of their houses, of their equipages, and of their general style of living, have also had the good sense to imitate their moderation as to the use of spirits. Thus, from the whole we have said, it is clear that, contrary to what generally happens with some other vices, drunkenness seems to be gradually abolished in Russia with the advancement of civilization.

Clarke, while he wofully degraded the male, unduly extolled the *female* population of Russia. Lyall, in greater consonance with other authors, for powerful reasons, will not admit this distinction. He has never been able to trace any marked difference between the manners and morals of the sexes in any part of Russia, and is of opinion that it never had more than an ideal existence. Wherever he found polished wives he also found polished husbands, and *vice versa*; and he supposes that the same vices are common to both sexes. He admits that some families are well educated, and that in them are women of purity and delicacy of character; but states decisively that chastity cannot be reckoned a prevailing virtue. While he seems pleased with their plausibility and their imposing manners, he reprobates their freedom of speech, which, if not immoral, is often very filthy. They are very sprightly and very gay, for ever dancing and singing, and laughing and talking. They have no delicacy of shape; and their complexions, from the liberal use of rouge, are what they please. Notwithstanding Clarke's opinion to the contrary, Lyall repeatedly alludes to the rareness of beautiful faces and elegant figures among the *ladies* of Russia. The causes of their general corpulency are assuredly gormandizing and indolence; and their comparison of themselves to *barrels*, though figurative, is very generally justified by truth. The traveller in his progress through Russia, meets with so few handsome and beautiful natives, that he is able to remember them all without any entry being made in his journal.

The wives of the Russian merchants, besides frequently blackening their teeth, use such a superabundance of paint, and laid on in so bedaubed a manner, that if they wished concealment it is altogether impossible. These ruddy women "waddle along under the burden of their pampered, sleek, and shining collops of fat, bedizened with all the magnificence that pearls and lace can bestow." The females among the peasantry are generally stunted, clumsy, round-faced, small-featured, and sallow complexioned. The wives of the clergy may be divided into two classes, those who are rich and those who are poor. The former in their persons and in their manners may be likened to the wives of the richer merchants; while the latter class, by far the most numerous, as it includes the greatest part of the wives of the *popes*, or parochial clergy, are nearly assimilated to the more opulent of the peasantry. As neither the wives of the merchants, of the clergy, nor of the peasantry wear corsets, nature is left to her full liberty of expansion. But, indeed, *de gustibus non disputandum*; for the common women reckon corpulency very comely in families, and they express their admiration in the strongest manner; and when they see a female with a slender waist, such as in England is reckoned the perfection of a fine shape, they pronounce at once that she is very ill, or that she is in a consumption. Even great-sized feet, and clumsy ankles, are highly praised.

We come now to the second class of the Russian population.

The clergy.

2d, *The Clergy*.—The high clergy, who are all monks, are generally men of considerable information. A few of them are distinguished for their learning in theology, their abilities as teachers, and their zeal in the cause of religion; some of them are exemplary in their lives, and mix now and then in polite society. The lower orders of the clergy, by far the most numerous—including the *popes*, or parish priests—with a few exceptions, know little beyond the performance of the duties of their calling. Few of them are worthy men; most of them are dissolute and irregular in their lives, and freely indulge in potations of spirits. They are rarely seen in genteel society, and by no means receive that attention or deference to which their holy calling, combined with a better education, might entitle them. They are in the primitive stage, in so far as regards theology. With respect to customs and manners, and general mode of life, some may be said to be in the imitative stage of civilization,—a step more elevated than the peasantry; while the bulk of them cannot claim that distinction. The late Count Orlof, in a letter to Rousseau, among other inducements, held out to him to come to enjoy tranquillity in Russia, made use of the following remarkable sentence: "The pastor of the parish neither knows how to dispute nor to preach; and the sheep, in making the sign of the cross, verily believe that all is done." With such instructors it cannot be expected that the peasants should make much advancement in the knowledge of religion, or that they should be much better versed in the truths of Christianity, than were their more savage ancestors of the eleventh and twelfth centuries. This fact is easily explained. The oppressive daily services of the Russo-Greek religion, with its numerous and tedious ceremonies, force the priests to make all possible dispatch to a conclusion, in the same manner as artists make every exertion to finish their manual labour. They act, in general, like pure machines, in which the passions are quiescent. The people follow the example of their teachers, and perform their religious duties,—crossings, prostrations, and chantings,—with perfect lukewarmness. They have been in church, and that is enough; their peace is made with their Maker, at least they soothe themselves with such ideas. Of late, however, some active and pious clergymen, aware of the above facts, have been in the custom of delivering short sermons to their flocks, especially on festivals, and have anxiously inculcated greater attention to the duties of the moral law. In this respect they are doing "*good service*;" for the grand defect in the character of the Russians, nobles and clergy, merchants and peasants, is an almost total and universal neglect of the duties which that law, happily for mankind, imposes upon all nations of the earth, and upon all ranks and ages.

We shall now speak of the third class of society.

The merchants.

3d, *The Merchants*.—The Russian merchants think of little else besides their affairs, and the accumulation and hoarding of money. Very few of them possess any knowledge beyond what is necessary for these objects, and the ceremonies of their religion. They are anxiously introducing improvements into all kinds of manufactures and trades; they are gradually, though slowly, depriving themselves of their beards; and they are making approaches to the modern mode of dress: indeed, a few of them have altogether adopted it. A number of the first, and even of the second guild merchants are very rich, and rival the nobility in their style of living. The third guild merchants, and the *Mestchanins*, or burgesses, are less refined; and most of them, having spent their younger years as serfs, strongly retain many of their original habits. The middling ranks, the *tiers etât*, which in Britain is chiefly composed of merchants, who are regarded as the pillars of this country, the source of her riches, the guardians of her glory, and the bond of union between the nobles and the people, scarcely have existence in Russia. The sons of the priests, the merchants and their descendants, the burgesses, and the free peasantry, (who have either received or purchased their freedom,) though they do not replace that useful body of the community found in some other countries, yet form a kind of *middling ranks*, comparatively speaking not numerous, who are for the most part in the imitative stage of civilisation; but a very few of them can be said to be completely civilized.

Dr. Lyall has portrayed at length the degraded character of the Russian merchants, and explained the peculiarities of their nefarious system of commerce, from long and busy observations made in the great theatre of their actions, the *Torgoviya Lávki*, or bargaining shops, at Moscow. In succession he speaks of their deceit, in demanding three, four, six, or even ten times the value of an article, or more than they accept of; in the adulteration of their goods and wares; and in the use of false weights and false measures: and then concludes his picture in these strong words, "The Russian merchants, shopkeepers, and dealers, cheat in the quantity, and in the quality, and in the price. If they miss their aim in the quantity, they succeed in the quality; and if they fail in both, it will be ten to one that they are successful in the price. The wary even are cheated in one or two of these ways, and the stranger is often duped by stratagem in all the three." Beyond all question, the Russian merchants have adopted the following maxim as the guide of their actions:

> The proper "value of a thing
> Is just as much as it will bring."

Throughout the Russian empire, the *Gostinnoi Dvores*, or the bazars, are the scenes of the refinement of deception and roguery. A set of sharpers, whose very countenances are indicative of their profession, assemble in them every day, and with their flattery, lies, oaths, and villainy, deceive the public to an enormous extent, while they fill their own pockets. They seem to forget the saying of our Lord, "With what measure ye mete it shall be measured to you." In their dealings no check is imposed upon their rapacity and fraud, by the fear of detection, the consciousness of shame, the sense of justice, or the love of honour. Speciousness, craft, dishonesty, swindling, lying, and even perjury, form the grand lineaments of the character of all the guilds of the Russian merchants and of the burgesses; and the interstices may be filled up, by adding the less prominent and allied vices which disgrace human nature. It may, however, be said with truth, that many of the Russian modes of villainy are not singular in the world. But there is one mighty difference between Russia and other nations in this respect. In Russia, it may be laid down as a fact, that the merchants, with a very few exceptions, all act upon the same nefarious system, whereas in other countries it is principally among the lower and the lowest classes of merchants and dealers that the refinement of roguery exists. The Russians are trained up to villainy from their youth; and the expertness of boys of eight and ten years of age in the arts of their masters is incredible; they are children in almost in every thing, but men in deception. And so widely diffused is the system of imposition, that even the peasant, who knows little beyond his field, his yard, his horse, and his *teléga*, (a small cart,) is a perfect knave when he comes to market. Unfortunately also, the same system prevails wherever the Russians have conquered, or treacherously acquired new dominions. The Tartars in the Krimea, and the Georgians at Tiflis, have completely adopted the Russian mode of commerce with all its detestable details. Should the ferocious mountain tribes of the Kaucasus be brought under subjection, one of the first changes from their primitive state will be the acquisition of the art of deceit in all its bearings and refinements. This is proved by the progress which some of the less savage of them have already made in that vice by their commerce with the Russians.

According to Dr. Lyall, "while the moral degradation of the merchants rouses our indignation and disgust, it awakes our sympathy and compassion. But alas, no speedy change is anticipated, because their pitiable state is deeply entwined with the wofully corrupt administration and the political condition of the empire; it forms one of the rotten spokes of one of the rotten wheels which hitherto have kept the mighty rotten machine of civil administration in motion."

4th, *Peasantry.*—The fourth and last class of the subjects of Russia is composed of the peasants. As they form the bulk of the population, and are all slaves, their real condition deeply interests humanity, and deserves serious attention; more especially as the widely different accounts of authors, of equal veracity, have tended much to perplex public opinion. Dr. Clarke's lively delineation of the extreme misery of the state of the slaves excited much interest and general indignation against their proprietors; but Dr. Lyall, who has paid the greatest attention to this subject, charges the late distinguished professor with extravagance and calumny, and ridicules his account of the peasants of Russia being fed upon "*the bark of trees, chaff, and other refuse, quass, water, and fish-oil.*" Indeed, in consonance with a number of other authors, he says, that the peasantry of Russia generally live well. They highly esteem their black bread, an excellent wholesome and nourishing article; their *kvass*, when good, a simple pleasant drink; their *stchi*, or cabbage-soup, sweet or acidulated; their condiments, salt, leeks, onions, and garlic; articles to be found everywhere in Russia; their salted cucumbers; their *kasha*, or boiled millet, eaten with butter or with oil during the fasts; their milk, which in the country at least, is generally added to the articles of their diet, as also eggs, and vegetables, and especially mushrooms; besides, at times, butcher's meat, and various kinds of pies on Sunday and festivals. The poorest fare, except in time of famine, even a Russian is reduced to, is formed of black bread and salt, boiled millet and butter, all nutritive substances. Because many of the articles of food and the *kvass* of the Russians, are not highly esteemed by travellers at their first arrival in their country, it is not to be supposed that they are bad, or coarse, or unhealthy. Foreigners, after a residence of some time in Russia, often become extremely fond of all the articles of the Russian boor's table; and the peasantry would not exchange them for the luxuries of Asia and southern Europe, nor indeed of the world. Although Dr. Lyall is of opinion that the generality of the peasantry fare well, and that their lot is comfortable, yet he candidly admits that numbers are oppressed, and most inhumanly treated. When some of the rich nobles, in consequence of dissipation and debt, are pressed for money, their serfs are among the first who know the fact, and who experience their impatience and rapacity. The *obrok*, or yearly capitation tax, is augmented, or demanded before the regular time, or conditions are sometimes offered in order to obtain more easily the fulfilment of their desires. But such a demand is like an imperial ukáz, it has a despotic influence; for the vassals well know that noncompliance with it, if within their capability, would draw vengeance upon themselves. They well know the genius of their master, and carefully remark his humour and his general way of action; and as they are very cunning, they secrete their property, and invent a thousand excuses. But it is chiefly the vassals of the *poor* and of the *extremely poor* nobles, whose case calls for sympathy and commiseration. The necessities of their lords, when combined with avarice or rapacity, reduce humanity to the most abject condition. It is not merely in respect of money that the peasants are oppressed. The time fixed by law which they ought to have for tilling their own land, and managing their own affairs, is directly encroached upon, or almost altogether taken up with their master's work. They themselves, their wives, and their children, and their horses, are continually occupied in labouring for their lords, or in advancing some favourite scheme. Regret is generally evinced when new buildings or gardens are among the plans of their proprietors, as they are well aware there will be new exactions on their time and toils. Part of their sorrow also flows, at times, from the prospect of no indulgence in indolence. Even when the boors wish to refuse compliance, and to speak their minds, they lose courage, and to avoid increasing the misery of their lot, they are altogether mute. They know they are sometimes oppressed, contrary to the laws of their country; but the laws generally are as a dead letter to them. How is a peasant to obtain redress who cannot quit the spot without his master's permission? And suppose he had reached the *courts of justice*, what could he do? He may complain of his lord, and become the instrument for an attorney to obtain a present or a bribe from his master, and thus the affair terminates. The peasants, when dreadfully oppressed, sometimes become exasperated, and sacrifice their tyrannical masters, in the same way as the nobles sacrifice their sovereigns. They resolve upon his death, and they accomplish it. More frequently, however, this is the lot of cruel stewards. The irritated boors unite in a body; the oppressor is murdered, and no single individual is responsible.

Some of the lords of the creation also make unjust demands upon the sheep, the calves, the hens, the chickens, the eggs, the milk, the cream, and the vegetables of their peasants; and at times they contrive that their people shall *make presents* of these articles to them. The stárost, or elder of the village, knowing the wants of his master, counsels the vassals *to offer of their own accord* what they know may be taken from them. Sometimes less ceremony is used, and an order is sent to each peasant of a village to produce forty or fifty eggs, get them where he likes, so that his lord may have abundance to prepare for the grand festival at Easter; when, according to the custom of the country, boiled and stained eggs are presented to friends, and even to every individual who enters another's house, however low may be his rank. Even the coarse linen, which is made by most of the females in the village, is sometimes shamefully pillaged, or asked under various pretences. The lot of the peasants of the richer nobles, as those of most of the Sheremétefs, the Galitsins, the Dolgorukiis, the Orlofs, &c. seems as much to be envied by common people, as that of most of those belonging to the very poor nobles is to be pitied. What a difference is frequently remarked between adjoining villages which belong to different proprietors. In some, indignation is roused at the sight of man oppressed by his fellow-man; in others, delight is excited with the parental care of the noble proprietor. Even the prejudiced and gloomy Dr. Clarke observed, that the system of slavery in Russia, like many other evils, may sometimes be productive of good. If the nobleman is benevolent, his slaves are happy; for by him they are fed, clothed, and lodged. In sickness they are attended, and in old age they find an asylum. In case of accidents from fire, if a whole village is burned, the nobleman must find wood to rebuild it.

To a Briton, a state of vassalage, though coupled with all the comforts and pleasures of the world, cannot but be regarded with the most painful emotions. But in a country where, by the doom of nature, slavery is the portion of the greatest part of the people, it is some consolation to find their condition even tolerable. The civil, the moral, and the religious state of the peasantry may easily be inferred from what we have said respecting the nobles, the clergy, and the merchants, and the statements now made; their vassalage, ignorance, and superstition, their customs, manners, and mode of life; and their dress, houses, occupations and amusements, all merit attention from the traveller. Their happy organization, hardiness, and sensuality, are very remarkable; and their improvidence, cheerfulness, and propensity to inebriety, as well as their national dances and songs, are quite characteristic. They are in the first or agricultural stage of civilization; they are therefore not in a state of barbarism; neither are they civilized, but they are making progress towards civilization, especially to the imitative stage. In Russia, where, comparatively speaking, so many manufactures, arts, and trades are carried on by the natives, to supply the necessities and luxuries of the civilized and polite part of society, the genius of improvement, though shackled by slavery and despotism, must be in activity. "What a contrast," says Lyall, "between the nomad tribes of Tartary, or the savage mountaineers of the Kaucasus, and the tranquil Russian boors, who till their own and their master's land, who tend their flocks and herds in the same spot from year to year, who are governed by laws, in some degree suited to their moral state, and who go on in the same beaten path of religion from birth to death?" The former are in a state of barbarism; the latter have assuredly quitted its precincts, and, it is to be hoped, under the generous auspices of the present sovereign; they will march forward with a steady pace toward that elevated state of highly civilized society from which they are far separated.

RELIGION AND BIBLE SOCIETIES.

Religion.—The established religion of Russia is that of the Greek church; the principles of which are explained under CHURCH, *Greek*, and therefore we shall not enter into them here. The church of Russia, by way of distinction, is often called the Russo-Greek church; but the difference of the ceremonies are so slight as not to require particular enumeration. Of the genius of the Greek religion we have already spoken, under the head *Character of the Russians*, in so far as it regards this people. As the following information contains much novelty, and throws great light upon the state of religion in Russia at present, as well as of the Bible Societies, we shall make no apology for making use of it.

An immense variety of images are worshipped in the Russo-Greek church. About 150 different images of the Virgin Mary alone, are well known in the Russian empire. They are named after some town, as the mother of God of Jerusalem, of Kazán, of Vladimir, of Smolénsk, of the Don, &c. Lyall's *Character of the Russians, and Detailed History of Moscow*, p. 156. These paintings are used as ornaments of the churches, or as objects of reverence in the national faith. Lyall, in the work just referred to, has given numerous accounts of these images in the churches of Moscow, as well as in the interior of the empire, which excite both curiosity and interest.

It has been pretended by native divines, that the Russians "do not attempt to draw upon the canvass a representation of the unseen and incomprehensible God, whom we never can represent;" but this statement is contradicted by facts, for almost every church in Russia is adorned with pictures or images of the Lord God of Sabaóth, or of the Holy Trinity. In Lyall's work, various views are given of the different manners the invisible Lord of Hosts has been represented, which, as that writer has observed, enable us to estimate what ridiculous flights the unguided imagination, and the impious pencil have made among the sublimest subjects which can occupy the thoughts of man.

It has also been attempted to show the difference beween an "*affectionate salutation*" to the pictures, and the *reverence* or *adoration* of them. But this is a distinction which not one in ten, perhaps in twenty of the nobles observes, and which assuredly is unknown among the illiterate peasants who form the mass of the population of the empire, and who entertain the highest superstitious and idolatrous ideas about those pictures, as well about the *mostchi*, or relics, and the powers of departed saints. The general impression, therefore, both upon ancient and modern authors, from different countries of Europe, seems to have been, that most of the Russians were, and are idolaters. Dr. Lyall thus expresses himself on this point. "If the worship of pictures be reckoned idolatry, and contrary to the second commandment, as is the case in my humble opinion, I fear no defence can be offered against the propriety of the appellation (idolatry). How often have I beheld with deep sorrow, that reverence and adoration due to God alone, bestowed on the saints, and the holy images or pictures, and relics! And in conversations with the peasants, when Christian charity was inclined to regard their actions with every indulgence, how frequently has my conscience told me that there was no palliation of the broad charge of idolatry. Some of the nobility, however, must be exempted."

Besides the worship of images, as they are called, mere paintings, Dr. Lyall charges the Russians also with the worship of graven images, and gives an account of a number of them which he has seen in the empire. It is notorious that one of these graven images is placed in the centre of Moscow, nay, in the very centre of the Kremle, and at the side of the great cathedral of Moscow. It is a gaudy statue of St. Nicholas, the tutelary saint of Russia, made of some composition, or cut out of wood, or of some other material. As this is a novel and very striking fact, the Doctor has given a representation of this celebrated image, to which particular adoration is paid on the 6th of January, the name's-day of Saint Nicholas.

The following comprehensive statement from Hassell, gives a good view of the religions of the Russian empire:—

1. *Greek*, - - - -	Proper Russians, Little Russians, Kozáks, Raitsens, Laplanders, Permians, Ziriances, Vogoules, Tcheremiss, Votiaks, Ostiaks of the Ob, Teptiars, Kistimers, Georgians, Koibals, Kamstchatdals, Greeks, Arnaouts, Vallachians, Moldavians, Bulgarians, the majority of the Gipsies and Prozelytes of all nations.	34,000,000
2. *Catholics and United Greek*, -	Poles, Lithuanians, French, Germans; of the last a small number.	5,308,000
3. *Lutherans*, - - - -	Lettes, Courlanders, Fins, Esthonians, Swedes, Danes, a majority of Germans, and many Poles.	2,500,000
4. *Reformed*, - - - -	British, Poles, a few Germans in Livonia.	33,000
5. *Armenians*, - - - - -		70,000
6. *Herrehutters*, Germans, - -		8000
7. *Menonites*, Germans and Poles, - -		3000
8. *Mahomedans*, - - - -	Kazán, Tauridan, and Astrachán Tartars, Turalintsi, Barabintsi, Kubán, Astrachán, Kundurovsky, and Tauridan Nogays, Kumykens, Basianes, Truchmenians, Kirghis, Aralians, Karakalpaks, Tchivintsi, Bucharians, Mestcheriaks, Bashirs, Circassians, Avtchases, Leghi, Osmanens, Persians, Kisilbashens.	1,800,000
9. *Jews*, - - - - -		210,000
10. *Lamutes*, - - - -	Mongoles, Kalmuks, Burati, Kurilians.	300,000
11. *Brahmins*, Hindoos, - - - -		300
12. *Shamans*, - - - -	Tchuvashes, Mordvas, Ob and Verchotomsky Tartars, Tchulimers, Katchintsi, Tulibertsi, Biriusses, Abintsi, Sayannes, Beltisi, Teleutians, Yakuti, Ossetinians, Jugushi, Tchitchentsi, Mikshesi, Karabulaks, Tungusi, Lamutes, Samoyedes, Soyotes, Matorens, Tubintsi, Kaimashi, Karagassi, Koriaks, Tchuktchi, Yukhagiri, Juralens, Arentsi, Assanens, Kotovzens, Ostiaks, Aleutians.	500,000

As the effect of the Bible Societies is ultimately connected with the religious state of the realm, we shall notice their present state.

The utility of Bible Societies has been highly extolled by some, and extravagantly abused by others. Dr. Lyall's opinion, therefore, may be of some consequence, in enabling us to judge for ourselves, at least in so far as regards Russia. "The empire," says he, "is not ripe enough to receive all the benefits anticipated from them by some; but a few seeds may fall into good ground, and in time may send forth blooming fruits, amidst the wide extended field of tares. Religion paves the way for morality, refinement, and civilization, and establishes a sure basis for the arts and sciences, philosophy, and literature; and therefore Britons must rejoice at the flattering testimonials with which their offers, in behalf of Christianity, were hailed, and the almost unexampled encouragement and success which the plan of Bible Societies has had in Russia. Their effects may be felt when the present race has passed away; and the names of their patrons may be lisped by innocence, and pronounced with esteem and reverence by after generations. It is not my province to dictate to so enlightened bodies of men, as are at the helm of these sacred affairs; but I cannot avoid wishing, that a general system of introductory education made a chief object of so noble a pursuit as the illumination of the minds, and the salvation of the souls of our fellow-mortals. The institution of Bible Societies in Russia, will form a remarkable epoch in the history of the present reign; and the uncommon interest taken in their prosperity by Alexander, will reflect eternal lustre upon the memory of that monarch. The degraded and melancholy views, which truth has forced me to bring forward of the character of the Russian nation, so far from dispiriting the friends of Christianity, and of Bible Societies, will only tend to excite their energy, and to the device of new schemes for making known the great truths of religion."

FINANCES.

Finances.

For a particular account of the finances of Russia in former times, we refer the reader to Tooke's "*View of the Russian Empire*," and his "*Life of Catharine II.*"

In the year 1816, the revenues of the crown amounted to 215 millions of roubles, and consisted of,

1.	Revenues from the crown domains,	40,000,000
2.	state monopolies,	56,000,000
3.	taxes,	108,000,000
4.	sundries,	4,000,000
5.	natural of the subjects,	

Vide works of Hassell, p. 226, and of Cromé, p. 77—80.

The expenditure of the crown in 1764, was 14,305,548 roubles; in 1790, it was 35,000,000; in 1802, it reached about 70,000,000; in 1811, it amounted to 274,000,000; and although we have no very certain data, it is known that the sum has annually augmented since that period. But we can place little faith in the reports of the Russian government.

The expensive wars in which Russia has been engaged within the last century, have gradually brought her into arrears to the amount of 400 or 500 millions of roubles, and perhaps to a much greater extent.

With a revenue of 215,000,000 roubles, and an expenditure of 274,000,000, the empire of the north was getting rapidly into debt, and was obliged to issue paper-money, from time to time, to an immense amount. The value of the paper rouble has gradually sunk from being the representative of 3s. 6d., or even more, to be only equal to 9d. sterling; and for a number of years past it has chiefly varied between 9d. and 11d.

In the year 1822, the Russian government, in order, it was said, to diminish the quantity of paper money in circulation, and to carry on plans for the general improvement of the country, contracted a large loan with Messrs. Rothschild & Co. at London, bearing interest at the rate of 7½ per cent. The money accordingly was remitted to Russia, and the supply, it was expected, would have produced immediate advantages, especially to commerce. But, if Dr. Lyall be correct, this was not the case. In the Courier and in the Morning Chronicle, a few months ago, this gentleman stated, upon what he esteemed indubitable authority, that the castle of St. Peter and St. Paul at Petersburgh was filled with uncoined silver and gold, and that the massy ingots of the yellow metal sent from England had not been coined into current money in order to help the exchange. He further says, that they are filled up as a store of tangible, and everywhere, valid cash, for the days of emergency. His inference from these facts is, that Russia has some grand plan in view for the employment of this idle money—some invasion and conquest, which it is calculated will repay all the lost interest, and compensate all the disadvantages to the nation at large which are now sustained by hoarding up the valuable metals.

Mr. Soimof and Dr. Fachs have lately made a visit to the Ural Mountains, on purpose to examine some recently discovered gold mines, the richest of which are said to lie between Nijni Tagilskoi and Koushetoumskoi. It was expected that the whole of these mines would furnish 130 poods, 6760 pounds troy, the first year, and of course that the quantity would be augmented in succeeding years. Should this be the case, Russia may receive a very seasonable increase of her revenue, and be enabled to pay off her debts, or to carry her ambitious plans into execution.

The following public letter gives the latest intelligence on the present subject:

St. Petersburgh, July 14th, 1824.

"On the 3d of this month, the council entrusted with all affairs relative to public credit, had a sitting in which the minister of finance, lieutenant-general V. Cancrin, presented a report on the state of finances in the course of last year. From this report, which gives a very favourable account of the improvement of the finances, it appears, that on the 1st of January, 1824, the whole of the public debt amounted to 20,620 roubles in gold, 91,534,318 roubles in silver, 260,628,677 roubles in paper, and 47,600,000 florins of the Dutch loan."

GOVERNMENT.

Government.

Russia has generally been an hereditary empire, and the crown has devolved to either sex. The pretended elections of some of the sovereigns, beyond doubt, were the result of intrigue and delusion. How can there be an election where the people are slaves, and have no voice, or where, if they had any, they would be governed by their masters' will?

The sovereign must be of the Greek religion, as well as his spouse, if he be married. His person is sacred, and his powers unlimited. On ascending the throne, proclamations announcing the event are issued at Petersburgh, and the monarch afterwards proceeds to Moscow, where the crowning takes place in the Cathedral of the Assumption.

To give a full idea of his numerous titles, we shall copy the commencement of every important ukáz, or proclamation:—"By the helping grace of God, we, Alexander I. *imperator* and *samodérjets* (emperor and autocrat) of all the Russias, *tsar* (king) of Moscow, Kiéf, Vladimir, Novgórod, *tsar* of Kazán, *tsar* of Astrachán, *tsar* of Poland, *tsar* of Siberia, *tsar* of Kherson, and of the Tauridan Chersonnesus, *gosudár* (sovereign) of Pskof, and *velikii kniaz* (great duke) of Smolensk, of Lithuania, of Volchinia, of Podolia, and of Finland, *kniaz* (duke) of Esthonia, Livonia, Courland, Semigallia, Samogitia, Bielostock, Karelia, Tver, Ugoria, Perm, Viatka, Bulgaria, and other countries, *gosudár and velikii kniaz* (sovereign and great duke) of Novgórod, of the lower country, (Nijnii-Novgórod) of Tchernigof, Riasan, Polotsk, Rostof, Yaroslaf, Belo-Ozero, Udoria, Obdoria, Kondia, Vitebsk, Mstislaf, and of all the northern region, *povelitel and gosudár* (emperor and sovereign) of Iveria, Kartalinia, Georgia, and Kabarda, hereditary *gosudár* (sovereign) and ruler of the Circassian and Mountain (Kaucasian) princes, successor of Norway, duke of Shlesvick-Holstein, Storman, Dithmarsen, and Oldenburgh," &c. &c. &c.

The Russian monarch has ever had unbounded power; his will has always been the legislative authority. Russia, strange as it may seem, has prospered under despotism, and always suffered wherever an attempt has been made to diminish or bound the sovereign power. The efforts, however, have probably not been made with sufficient vigour and determination; and the nobles feared a power divided between the throne and a senate, more than the arbitrary orders of a despot which overrule every court of judicature in the realm. The sovereign can enact new laws when he pleases, or make alterations of those already existing; he can make war or peace, raise taxes, levy recruits, grant privileges, confer titles and dignities, ecclesiastical and civil, military and naval; he can establish or abolish monopolies, impose new taxes, or abrogate old ones; he can make presents of, or sell domains at pleasure, or increase them by purchase, conquest, and negotiation. Even the sole legislation of ecclesiastical matters may be said to centre in him. He can also travel out of the empire, and appoint a regency during his absence.

Under such a power, a country of slaves may be happy, or excessively miserable, according to the humour and will of the potentate. There is no counterpoise to oppression or to violence but the conscience of the autocrat; and if he be a merciless or foolish monarch, his people's fate becomes most lamentable. In fact the tsar, or emperor, may be said to be absolute lord both of the empire and of the laws of his subjects. He commands the nobles; but if his rule be severe he may forfeit his life, as was the case with Paul. The property of the nobles is also directly or indirectly at the sovereign's disposal.

By the common people the emperor is truly regarded as the Lord's anointed, and revered as a supernatural being.

AGRICULTURE.

Agriculture.

A dissertation upon the agriculture of Russia would little interest our readers, and would lead to the development of few facts of great importance. Herrmann, in treating of this subject, informs us that, according to all data, the general extent of Russia is 1,473,881,726 desiatins, of which 402,100,552 belong to European Russia, and 1,071,781,174 to Siberia, or Asiatic Russia; and that the tilled lands may be reckoned at 61½ millions, the woods and forests at 156, the meadows at $\frac{7}{223\frac{1}{2}}$ *millions* of desiatins; and that there remain 178½ millions for the site of buildings, the roads, water, and uncultivated land.

The same author treats at length of the cultivation and the products of Russia, and enters into many minute calculations.—*Memoires de l'Acad. Imp. de St. Petersb.* vol. viii. p. 399.

The Free Economical Society of St. Petersburgh, and the lately established Society of Agriculture at Moscow, are now actively employed in the improvement of the Russian empire, and no doubt their effects will be felt in distant times. The society last alluded to is formed upon a very excellent plan, and combines the theory and practice of agriculture together in its school kept on purpose.—Vide *Appendix* to Lyall's work so often referred to.

MANUFACTURES.

In vol. viii. p. 435 of the *Mem. de l'Acad. Imp.* of St. Petersburgh, there is a paper by Hermann, entitled " A Glance at the State of Manufactures in Russia, and at the Principle of her manufacturing Legislation, from the sixteenth century till the year 1814," which is in fact an abridged history of commerce; and in the same volume, p. 454, there is another dissertation, " Views of the State of Manufactures in Russia since 1803 till 1814," that contains many details and tables, which well demonstrate the thriving state of the fabrics and manufactories of Russia. The author compares the number of cloth manufactories, linen manufactories, silk manufactories, tanneries, soap works, glass works, paper manufactories, cotton manufactories, rope works, sugar works, fabrics of steel and iron, of copper and buttons, of candles, of hog's-lard, tobacco pipe manufactories, manufactories of porcelain, &c. in 1812 and 1814, to show the relative increase of their produce, and the additional number of hands employed. As is evident from his statements, the number of tanneries, of iron and steel fabrics, and of cotton manufactories, has especially augmented; and so have also the cloth manufactories, the soap works, the hog's-lard and candle works. But it may be generally stated, that there is no kind of manufacture which is not increased.

At all these manufactories there were employed, in 1812,

31,160	peasants belonging to the crown.
27,292	do. do to individuals.
60,641	free workmen.
119,093	

It is interesting to remark, says Herrmann, that the umber of free workmen already surpasses that of the easants, in an empire in which they scarcely existed.

The fabrics natural to Russia, the tanneries, the rope works, the linen manufactories, the candle works, and he soap works, have a well *established reputation*. The lass works, the paper works, the iron fabrics, the steel abrics, the copper fabrics, as yet do not equal foeign establishments; but they have made considerble progress in improvement. The manufactories of cloth, of silk, and of cotton, have not yet attained that degree of perfection to be able to compete with those of foreign countries; but of late they have also made great advancement.

Russia.

The government seems peculiarly anxious to render Russia a manufacturing nation, whereas it is by nature an agricultural country, and ministers may be grossly deceived by the results. It is one great object of the crown, and a favourite object, to have fine cloth made in Russia, such as the superfine English; but all efforts at competition have as yet entirely failed.

From comparative tables also given by Herrmann, of each kind of fabric established in the different governments of the empire, it is evident that although Petersburgh and its immediate vicinity, and the government of Moscow, with a number of governments to the east, south, and west, form the chief manufacturing districts, yet that some kind of manufactories are to be found in every part of Russia, and that tanneries and soap works are numerous in Siberia.

ANIMALS.

Animals.

European Russia is not so abundant in wild animals of great size, as *ci-devant* Poland and the middle of Asia. The immense deserts of Siberia are still poorer in this respect than Russia. Wild animals are not vigorous, and do not multiply except in the neighbourhood of mountains, and in temperate climates; and Russia only possesses three considerable elevations, the Ural Mountains, the Caucasian Mountains, and the chain of mountains which rise toward the middle of Asia. It is here that the inhabitants of the woods and of the deserts are of great size, and are numerous. The vast plains of Russia and of Siberia, on the contrary, only possess small animals of the race of dogs and mice; and the northern countries have scarcely any wild quadruped distinguished by its size, except the sea-bear, which is peculiar to the Arctic zone, and which belongs as much to the sea as to the land, and the rein-deer, which spread by the mountains even to the middle of Asia, which appears to be their true region, as also that of horses, wild asses, and antelopes. The north is the country of dogs and of mice; the south possesses lions, tigers, leopards, and elephants.

The most interesting wild animals in Russia are those whose furs are articles of commerce. Their number amounts to 26 species, the principal of which are the sable, the sea-otter, the marten, the fox, the grey squirrel, the bear, the wolf, the wild rein-deer, &c.—Vide *Memoires de l'Acad. Imp. de St. Petersbourg*, vol. v. p. 628.

IMPERIAL ARMS.

Imperial arms.

The imperial arms consist of a black, two-headed, three-crowned eagle with spread wings, holding a golden sceptre in the right claw, and in the left a golden imperial globe. On its breast are George and the Dragon, or the arms of Moscow; on the right wing are the arms of Kiéf, Novgórod, and Astrachan; and on the left those of Vladimir, Kazán, and Siberia, and around the shield of the imperial eagle is the cordon of St. Andrew.

In the great imperial seal, besides the above, are placed, in a circle, the arms of all the other governments and provinces of the empire.

ORDERS.

Orders.

Russia possesses six orders, viz. 1st, The order of St.

Andrew; 2d, St. Catharine; 3d, St. Alexander Nevskii; 4th, St. George; 5th, Vladimir; and 6th, St. Ann.

CLASSES OF THE POPULATION.

Classes of population.

The population of Russia is properly divided into four great classes, the nobles, the clergy, the burghers, and the peasants, each of which has its peculiar rights. The nobles are divided into classes, which are of greater importance in the estimation of the public than the titles of princes, counts, or barons, &c. The clergy are divided into the regular and the parochial: the first of whom are all monks, and the second form the parish priests. The merchants are divided into three guilds, and with the *mestchanins*, or simple burghers, compose the third class of the Russian subjects. The peasants, who form the bulk of the nation, are nearly all slaves, *glebæ adstricti*, and belong either to the crown, or to individuals. Within the last few years the emperor Alexander has endeavoured to better their condition, by allowing their masters to emancipate them, if they choose; but the offer has scarcely been embraced, nor is it likely to be of much use.

Of all the classes of the Russian population we have spoken in another part of this article; and therefore shall conclude by remarking, that those peasants who have obtained or bought their liberty, and the *odnovortsi*, or possessors of one house, are, comparatively speaking, but few in number; and that the Little Russians, the Kozáks, the Georgians, the Bashkirs, the Kalmuks, and other wandering and Asiatic tribes, have a peculiar constitution, and enjoy particular immunities and privileges; as do also the many colonists, especially Germans, who are scattered throughout every part of the empire.

Respecting the Russian empire, the following works may be consulted with great advantage:

Authorities.

Géographitcheskoi Slovár Rossiiskaho Gosudárstva; or a Geographical Dictionary of the Russian Empire, in 7 vols. 4to. Moscow, 1801-1809, by Stchékatof.

Dictionnaire Geographique Historique de l'Empire de Russie, by Vsevolojskii.

Storch's *Gemälde des Russichen Reichs.*

Cromé's *Allgemeine Uebersicht der Staalskrafte.*

Hassel's *Staats und Address-Handbuch der Europaischer Staaten.*

Istoria Rossiiskaho Gosudárstva; or the History of the Russian Empire, by the distinguished Karamzin.

Recherches Historiques sur l'Origine des Sarmates, des Esclavons, et des Esclaves. By Stanislaus Sestrenevitz de Bohujz.

Histoire de Russie, by Levesque.

Histoire de la Nouvelle Russia, by the Marquis de Castelnau.

Histoire Militaire de la Campagne de Russie en 1812. by Colonel Bouturlin.

Napoleon's Expedition to Russia, by Count de Segur.

Memoirs of the Imperial Academy of Sciences at Petersburgh.

Pallas's, Gmelin's, and Klaproth's *Travels in various Parts of Russia.*

Tooke's *View of the Russian Empire.*

Tooke's *Life of Catharine the Second.*

Tooke's *History of Russia.*

Coxe's *Travels in Poland, Russia, &c.*

Clarke's *Travels in Russia.*

James's *Journal of a Tour in Germany, Sweden, Russia, and Poland.*

Mrs. Holderness's *New Russia.*

Lyall's *Character of the Russians, and a detailed History of Moscow.*

Lyall's *Account of the Organization, Administration, and present State of the Military Colonies in Russia.*

Lyall's *Travels in Russia, the Krimea, the Caucasus, and Georgia.*

Cochrane's *Narrative of a Pedestrian Journey through Russia and Siberian Tartary.*

Holman's *Travels through Russia, Siberia, Poland, Austria, &c.*[*]

RUST. See AGRICULTURE, Vol. I. p. 292.

RUTA BAGA. See AGRICULTURE, Vol. I. p. 308.

RUTHERGLEN, or RUGLEN, a royal burgh and market-town of Scotland, in the county of Lanark, has an elevated situation on the south bank of the river Clyde, about 2½ miles south-east from Glasgow. The town consists of one principal street, about ¾ths of a mile long, and 100 feet broad; and of a lane called the Back Row, lying parallel to it, and running from east to west. The old church was taken down in 1774, and a new one built in its place. The castle of Rutherglen was burned by order of the regent, after the battle of Langside. Many of its sculptured stones may be seen built into the walls adjoining the town. The principal manufacture here, is that of weaving muslins for the Glasgow manufactories. There are here six annual fairs for their show of horses of the Lanarkshire breed, which are deemed the best draught horses in Scotland. This burgh joins with Glasgow, Renfrew, and Dumbarton, in sending a member to parliament. Population 1630. See Denholm's *History of Glasgow*, and the *Beauties of Scotland*, vol. iii.

RUTILE. See MINERALOGY *Index.*

RUTLANDSHIRE, one of the interior counties of England, is bounded on the north, north-west, west, and south-west, by Leicestershire; on the south and south-east by Northamptonshire; and on the east and north-east by Lincolnshire. It is nearly of a circular figure, and is the smallest county in England. Its superficial contents, according to the trigonometrical survey, amount to 149 square miles, or about 95,360 acres. It is divided into five hundreds, which contain forty-nine parishes, and two market towns, Oakham and Uppingham, the former of which is the county town. It returns only two members to parliament, there being no boroughs in the county.

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[*] The two last travellers are very singular. The one performed a great part of his journey on foot; the other is TOTALLY BLIND, and, after reaching Irkutsk, was sent out of Russia.

The general aspect of the county is extremely beautiful, being diversified by small and gently rising hills, which are intersected by woody vallies about half a mile in width, so that in travelling fresh prospects continually open on the view. In the centre of the county is the pleasant and fertile vale of Catmose, which, if we may trust a conjecture of Camden's, derives its name from *coet maes*, which signify in British a woody plain. To the north of this vale the ground rises; and on leaving Oakham, and ascending Burleigh hill, there is an extensive level which stretches over all the northern district, and forms a kind of table land, looking down on the fertile plains of the surrounding counties; the eastern part of the shire is more diversified; the southern district consists of one extensive open valley, stretching into Northamptonshire; and the western parts are well wooded, and gradually sink into the plains of Leicester.

This county is considered as being well watered for agricultural purposes, chiefly by springs and ponds. The only rivers of any note are the Guash or Wash, and Welland. The former rises in Leicestershire, enters Rutland at Greatham, and flowing in an easterly direction through the centre of the county, divides it into two equal parts, and, after a course of eighteen or twenty miles, falls into the Welland a little below Stamford. The Welland also has its source in Leicestershire, and first touches upon Rutland near Caldecot, whence it flows with a winding course towards the north-east, forming for a considerable distance the boundary between Rutland and Northampton, after which it passes Stamford, where it becomes navigable, crosses the fens of Lincoln, and falls into the Wash.

The internal communication has been considerably facilitated by the Oakham canal, which was commenced in 1793, and completed in 1803. It begins in the vicinity of Melton Mowbray in Leicestershire, enters Rutland near Teigh, and proceeds in a south-easterly direction, passing by Market Overton, Barrow, Catmose, and Burley, until it approaches Oakham, the centre of the county, on the north side, where it terminates.

The climate of Rutlandshire does not differ materially from the other inland counties; it is considered as mild, pleasant, and extremely healthy. According to a very accurate journal kept by Mr. Barker, the annual average quantity of rain for eight successive years was 24.61 inches. Chalybeate springs abound throughout the county, some of which are very strongly impregnated. There is a considerable variety of soils, not only in different parts of the county, but often on the same farm. According to Mr. Parkinson, they in general consist of red land, good clay, poor clay, hazel earth, white stony land, black clay, and gravelly clay. The east and south-east districts are of a shallow staple upon limestone rock, with a small mixture of cold woodland, and clay soil; the other parts consist of a strong reddish loam, except the vale of Catmose, which is composed of good clay, red loam, and a mixture of clay and red loam. The substratum of the whole county, at different depths, is a strong blue clay.

Owing to this diversity of soil, different systems of agriculture are necessary, besides the inclosed arable lands are under a different mode of husbandry from those which are uninclosed. The former, which mostly consist of the light soils of limestone bases and red loam, are under the Norfolk system of four years' rotation, and without feeding off, except in the turnip crops; it is usual to take two crops of spring corn after breaking up the clover, then turnips, next barley with rye-grass and clover; then three or four years sheep feeding, when it is broken up again for spring corn. The uninclosed arable lands are still under the old course of two crops and a fallow. In the following seasons the dead fallows are sowed with wheat, and some of the light soils with barley; the second crops generally consist of pease, or of a mixture of beans and pease. The size of farms varies considerably in this county, but in general they are very small; a farm of L.300 or L.400 a-year being esteemed very large. The average rent of lands, when Mr. Parkinson made his survey, was a guinea per acre, but it has since increased considerably. Nearly all the land is let from year to year; a very small number of farms being let on leases of 14 or 21 years. There is no breed of cattle peculiar to this county; but considerable numbers are brought from other counties, and after one summer's grazing, are sent to the London market. The whole number of sheep and lambs in 1807 was 81,146, consisting of old and new Leicesters, a few Lincolns, and some South Downs.

Manufactures.

There are no manufactures of any consequence in this county, which is ascribed to the want of water, and scarcity of fuel.

Minerals.

The minerals of this county are so trifling that they scarcely require to be noticed; at Kelton excellent stone is procured for building; and in many places there is stone for lime of a soft and hard species; these stones are deserving the attention of the naturalist, as they contain a great number of marine substances, and are of various degrees of tenacity from indurated clay to the consistence of stone. The presence of iron is indicated by the chalybeate springs, and by the red ochrey colour of the soil in several places. This property of the soil has been greatly exaggerated; an old writer states, that it is so red that it stains the wool of the sheep that feed on it of a red colour.

History.

The early history of Rutlandshire can scarcely be separated from that of the neighbouring districts. It originally formed part of the territories of the Coritani, and after the subjugation of the kingdom by the Romans, it was included in their province of Flavia Caesariensis. During the Saxon heptarchy, it formed part of the kingdom of Mercia, and after the union of the different nations under one monarch, it seems to have belonged to the crown, being bequeathed by Edward the Confessor to his queen Edith, and after her death, to Westminster Abbey. After the Norman invasion Rutland was granted by William the Conqueror to his niece Judith, and several others of his nearest relations. At that period it does not seem to have been of the same extent as at present, part of it being in Nottinghamshire, as appears from its entry in Domesday book.

Population.

The population of Rutland has remained for a long time nearly stationary. According to the various parliamentary returns, the number of inhabitants in 1801 amounted to 16,356; the number of houses were 3274, which were occupied by 3563 families; in 1811, the population was 16,380; and in 1821, it had increased to 18,487, of whom 9223 were males, and 9264 females; the number of houses inhabited were 3589, and the families 3936. The poor's rates are comparatively low, a circumstance which is ascribed to many of the cottagers being allowed as much land as keeps one or two cows. There are several friendly societies, and one entitled the Society for Promoting Industry which has been extremely beneficial to the poorer classes. The greater part of the parishes are exonerated from tithes, either by modus or being free. See the *Beauties of England and Wales*.

RUYTER, Michael Adrian de, a celebrated Dutch admiral, was born in 1607, and died in 1676. See Britain, Vol. IV. p. 600; and Netherlands, Vol. XV. p. 387.

RYAN Loch. See Wigtonshire.

RYE. See Agriculture, Vol. I. p. 298; and France, Vol. IX. p. 700.

RYE Grass. See Agriculture, Vol. I. p. 320, 323.

RYE, a market and borough town of England, in the county of Sussex, and one of the cinque port towns. It is situated on an eminence in the British Channel, at the mouth of the river Rother, and consists principally of an irregular street, the houses of which are of brick, and are in general well built, though old fashioned. The church, dedicated to St. Mary, is of stone, and is one of the largest parochial churches in the kingdom. There are also here meeting-houses for Methodists, Quakers, and other dissenters. The town-hall stands in the centre of the principal street, and has the market-house in the lower story. The trade of this place consists in hops, wool, timber, fish, cannon, and various articles in cast iron from the iron works of Bakeley and Breed. The mackerel and herrings caught here are reckoned the best of the kind. Many attempts have been made to improve the harbour, which lies to the south-east of the town, but it is still accessible only for small vessels, although hopes are entertained of deepening it. Some sloops belonging to this port, are constantly occupied in carrying chalk from the cliffs of East Bourne, for being burned into lime. There is here a free grammar school and a charity school. The corporation of Rye consists of a mayor, bailiff, jurats, and freemen. This burgh sends two members to parliament, who are elected by about 100 voters. Houses 476. Population 2681.

RYEGATE, Reygate, or Reigate, a burgh and market-town of England, in the county of Surrey, is agreeably situated in the fertile valley of Holmsdale, at the foot of a ridge of chalk beds. The town consists of two streets, which are in general well built, and contain many handsome houses and good inns. The High Street runs nearly east and west, and Bell Street north and south. The church, which is at the west end of the town, is built of square masses of chalk. It has two aisles, and an embattled tower of hewn stone, containing eight bells, and contains several handsome and expensive monuments. The market, built in 1708, is a small brick building, with piazzas below it. The block-house contiguous to it, was intended as a prison for felons.

The castle of Ryegate stood on the west side of the town, and some parts of its outer wall existed about thirty or forty years ago. There is still to be seen, however, a passage 235 feet long, which leads into a vaulted room 123 feet long, thirteen wide, and eleven high, excavated out of the solid rock. It was probably used by the insurgent barons as a store-house and a prison. About sixty years ago, about twenty mills were employed in grinding oatmeal, but only one small one is now in use. The inhabitants derive considerable emolument from the visitors of Brighton, and other bathing quarters. The burgh sends two members to parliament. Population 2410.

RYOTS. See India, Vol. XII. p. 88, col. 2.

RYSWICK, peace of. See Britain, Vol. IV. p. 615; and France, Vol. IX. p. 608.

RYEHOUSE Plot. See Britain, Vol. IV. p. 606.

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SAARBRUCK, or Sarrebruck, a town of Prussia, in the province of the Lower Rhine. It is situated on the river Sarre, which separates it from a small town called St. John. It has a Lutheran church and a gymnasium. Some manufactures of iron and steel articles are carried on here; but the principal employment of the inhabitants is derived from the trade on the river, which is here navigable. Population about 2700.

SAAVEDRA Michael de Cervantes. See Cervantes, Vol. V. p. 672.

SABA, one of the Caribbee Islands in the West Indies, belonging to the Dutch. It is about twelve miles in circumference. It produces subsistence for the inhabitants, and also the materials for several manufactures; but for the want of a harbour its commerce is very inconsiderable. The only access to it is by a road cut in the rock, which admits one person at a time; and, as this road is covered with stones, the inhabitants are able to repel any hostile attack. Indigo and cotton are raised in small quantities; but the principal manufacture is shoes. Great quantities of fish, particularly bonetos, are caught on the coast. West Long. 63° 12′, North Lat. 17° 40′. See Raynal's *History of the West Indies*, vol. iv.

SABIANISM, or Sabæanism, or Sabaism, is the doctrine of the Sabæans, or Sabians, a sect of idolaters more ancient than Moses. The Sabians believe in the existence of one God. They pay adoration to the stars, or to the angels or intelligences who are supposed to reside in them, and govern the world under God. They believe that the wicked will be punished for 9000 ages, and afterward received into favour. They consider the pyramids of Egypt as the sepulchres of Seth, and of Enoch and Sabi his two sons, whom they regard as the first propagators of their religion. A more full account of this sect will be found in Sale's *Preliminary Discourse to the Koran*, p. 19. See also Hyde's *Rel. Vet. Persarum.*

SABI, or Xavier, a town of central Africa, in the kingdom of Whiddah. It is situated about a mile from the sea, on the river Euphrates, in a very fertile country. It is large and populous. See *Modern Universal History*, vol. xiii.

SABINES. See Roman Empire, in this volume, p. 384.

SABLE. See Mazology, Vol. XIII. p. 417.

SAFFRON. See France, Vol. IX. p. 704.

SAFFRON, Walden, a market-town of England, in the county of Essex, which derives its name from the great quantity of saffron cultivated in its vicinity. It is a large and straggling place, situated near a branch of the Cain, on a narrow tongue of land, stretching out like a promontory, encompassed with a semicircular valley, and surrounded by verdant hills. The church, which has a very elevated situation on the top of an eminence, is a lofty and spacious pile of English architecture, consisting of a nave, chancel, and side-aisles. It is chiefly of the age of Henry VII. and VIII. and is considered by Walpole as one of the highest and most beautiful parish churches in England. It was repaired in 1791, at the expense of £8000. At the bottom of the tongue of land stands the ruins of a castle, which, from the fragments that remain, seems to have been a place of great strength. There are in the place meeting-houses for the Independents, Baptists, and Quakers. The charitable establishments are, an excellent free school, an alms-house, and clothing for twelve poor men, left by the late Lord Howard. There was formerly in the town a rich and extensive priory; and on the green behind the castle, there is a singular work called the Mazz, which is a number of concentric circles with four outworks, all cut in the chalk. It is supposed to have been a place of exercise for the British soldiery. The manufactures of Saffron Walden, are bolting cloths, checks, fustians, fine yarn, and sacks, and a considerable trade is carried on in malting. Population 3403.

SAGE, Alain René Le, a celebrated French writer, was born at Ruys, in Britanny, in 1677. At an early period of life he went to Paris as a professional author, where he soon obtained notice by a version of the Greek letters of Aristænes. Having studied the language and manners of Spain, he directed his attention to the composition of novels, the scenes of which were laid in that country. These works were, 1. *Aventures M. Gil Blas de Santillane*, 4 vols. 12mo. which is esteemed his chef-d'œuvre. 2. *Le Diable Boiteux*, 2 vols. 12mo.; and 4. *Estawanille, ou le Garçon de bonne Humeur*, 2 vols.

Le Sage was the author also of two dramas, namely *Crispin rival de son Maitre*, and *Turcaret*, which have been considered as exhibiting great dramatic talents. Le Sage died at Paris in 1747, in the 70th year of his age.

SAGHALIEN, Sogalien, Oku Jesso, or Upper Jesso, called by the natives Tchoka, is an island about 4° to the north of Jesso, about 450 miles long and 80 broad. It is separated from Tartary, in Lat. 52°, by the strait of Saghalien, which, though probably now navigable, is gradually filling up from the accumulation of sand by the river Saghalien, or Amur, which has a course of 1500 miles. The island is mountainous in the centre. The east coast contains wooded vallies and hills, behind which rise snow-covered mountains. To the south of the 51st degree the country consists of hills of sand. The soil is favourable to vegetation, and is covered with forests of fine oak, willow, and birch. The sea and the river abound with fish, particularly salmon of the best quality. An account of the Anios, who inhabit the southern and the western coasts, has already been given under our article Jesso, Vol. XI. p. 734.

SAGHALEN River, or Amur. See Physical Geography, Vol. XVI. p. *522.

SAGITTARIUS. See Astronomy, Vol. II. p. 770.

SAGO is a nutritive substance used in diet, and obtained from a kind of palm tree, called *Landau*, the *Cycas circinalis* of Linnæus, which grows spontaneously in the Moluccas. It grows also in Japan, and among dry and rocky mountains in Malabar. It is an universal article of food among the inhabitants of the eastern islands.

Sago is procured in the form of a gummy kind of meal, which lies between the filaments or fibres of the tree within the bark. The pure sago is obtained by mixing the whole sap with water, the filaments floating, and the sago falling to the bottom.

SAHARA. See Africa.

SAHLITE. See Mineralogy *Index*.

SAIDA, or Seida, a sea-port town of Syria, built on the site of the ancient Sidon. It stands on the north side of a hill, stretching along the sea 600 yards, and having a breadth of 150. It is ill-built, dirty, and filled with ruinous buildings. The castle is built in the sea, and is joined to the mainland by arches. To the west of this castle is a shoal fifteen feet high above the sea, and about 200 yards long; and between that and the castle is the road for vessels. On the opposite side of the town is a modern fort, consisting of a large tower. The town is surrounded with orchards and gardens, containing mulberry and lemon trees. On the southern extremity of the city there is to be seen close to the sea a large tesselated pavement of variegated marble, about ten feet of which is perfect, representing a horse, soldiers, &c. Many ancient granite columns are built into the wall, and some stand as posts to the bridge leading to the fort. There is a small square building, containing tombs of the emirs and the druses. Saida is the emporium of the trade of Damascus and the neighbouring country. Corn, silks, raw and spun cottons, the last of which constitute the principal employment of the inhabitants, are the chief exports. Population about 8000. East Long. 35° 14′, North Lat. 33° 25′. See Volney's *Travels in Syria*; and Browne's *Travels*.

SAILING. See Navigation.

SAINTFOIN. See Agriculture, Vol. I. p. 314. and France, Vol. IX. p. 702.

SAL-AMMONIAC. See Chemistry and Materia Medica.

SALAMANCA, a city of Spain, in the province of Leon, is situated in the form of an amphitheatre on the declivities of three hills, and on the banks of the Tormes, which washes its walls, and flows through its beautiful planes. This river is crossed by a stone bridge of 27 arches, and 500 feet long, supposed to be Roman. The city is defended by a wall with thirteen gates, and has several squares, fountains, and handsome edifices. The principal square, which is large, has piazzas all round it, the houses in it being uniform, and three stories high, with balconies in front continued all round. The architecture of this square is modern and elegant, and it is reckoned among the finest in Spain. It is encircled with a parterre of twenty arcades. The town-house occupies one side of the square, and several streets run from the other sides. Salamanca has twenty-seven parish churches and fifteen chapels, the university, twenty convents of monks, several of nuns, and several hospitals, &c.

Of all the edifices in the city the cathedral is the most imposing. It was begun in 1513, but not finished till 1734. It is 378 feet long, 181 wide, 130 high in the nave, and 80 in the centre. It is altogether a noble and majestic building; but the most striking parts of it are the sculptures that are over the principal gate, which are as fresh and sharp as if they had been newly put up. It has a superb steeple, surrounded by a handsome and spacious gallery, where several people can walk abreast. In front of the cathedral is a spacious square, paved with large square stones, surrounded with thick pillars about six feet high, connected by a strong iron chain, with openings for foot passengers. The church of the Dominicans is considered little inferior to the cathedral in its sculptures. The ancient church of the Jesuits, and that of St. Marc, merit notice; and also the handsome convents of St. Dominic, St. Bernard, and St. Augustine. The King's College, and the Collegios Majores de St. Bartolomé, are also much admired; the last of these being very large. All the colleges and convents have libraries, which contain some valuable MSS.

The university of Salamanca has long been celebrated. It was founded in 1239, out of the ruins of that at Palencia, and it is said to have contained at one time 15,000 scholars, of whom 7000 were foreigners. There are 61 professors, and in 1785 there were 1909 students; but within the last five years they are said not to have exceeded 300 or 400. The buildings annexed to the university consist of twenty-five colleges, each of which has accommodation for thirty students. Besides, there are four of what are called grand colleges, for young men of family. There is here an Irish college, built in 1614. The academical dress is a black cassock, like that of the priests, and the heads of the students are shaven, and covered with a cap. The library, which is spacious, contains some modern books; but the greater number are works on scholastic theology. The city abounds in beggars, as the hospicio, or general work-house, can only support 450 paupers. Here there are various useful machines and implements, particularly one for weaving tape, which is so expeditious that a little child can weave fifty yards a day, and a woman more than 120. Here is a Roman road leading southward to Merida. Population about 14 000. West Long. 5° 10′, North Lat. 41° 21′. See Laborde's *View of Spain*; and Townshend's *Travels in Spain*.

SALAMANCA, Battle of. See France, Vol. IX. p. 652.

SALAMANDER. See Herpetology, Vol. XI. p. 39.

SALAMIS. See Greece, Vol. X. p. 466.

SALDANHA Bay. See Cape of Good Hope, Vol. V. p. 394.

SALEM, a sea-port town of the United States, and capital of Essex county in Massachusets. It is supposed to be the second town in point of magnitude in the United States, and, except Plymouth, the oldest. The town is situated on a peninsula formed by two small inlets of the sea, called the North and South Rivers. Over the North River there is a bridge called Essex bridge, upwards of 1500 feet long, and erected in 1789. It connects Salem with Beverley. The South River forms the harbour, which has good anchorage; but vessels drawing more than thirteen feet of water are obliged to unload at a distance from the wharf.

Though the situation of Salem is low, it is salubrious. The houses, now mostly of brick, are well built, but the streets are irregular. It contains a court-house, a jail, a market-house, an alms-house, three banks, a custom-house, a grammar school, an asylum for orphans, a savings bank, a museum, an athenæum, with a library of 5000 volumes, four insurance offices, and eleven places of worship, viz. four of Congregationalists, two of Baptists, one for Quakers, one for Episcopalians, and one for Universalists. There is a handsome common of ten acres to the north of the town, surrounded with a public walk, and planted with rows of trees. Fort Pickering and fort Lee stand on a peninsula below the town; and there is a lighthouse on Baker's Island.

The inhabitants are principally employed in trade and commerce. The vessels engaged in the East India trade amount to 53, carrying 14,272 tons. The shipping belonging to Salem amounted, in 1816, to 34,454 tons. There is here an East India marine house, established in 1801, and consisting of persons who have sailed round the Cape of Good Hope, or Cape Horn. The museum, which contains many objects of interest, belongs to this society. The mean temperature of Salem, according to thirty-three years observations by Dr. Holyoke, is 48°.678 of Fahrenheit, 11° 76 lower than that of Paris, which is nearly in the same parallel in the old world. Population 12,613. West Long. 70° 43′ 37″, North Lat. 52° 33′ 20″. See Warden's *Account of the United States;* and the *Memoirs of the American Academy*, vol. iv. p. 386.

SALERNO, a city of Naples, and the capital of the province of Principato Citra. It is situated in a plain of limited extent, surrounded with finely cultivated hills. The town, however, is far from agreeable, the streets being narrow and irregular, and the houses lofty, which give it a gloomy aspect. The streets are paved with lava. The cathedral, which is the principal building, is by no means handsome. In front of it there are 28 ancient granite columns, with Corinthian capitals. Beside a number of other churches and convents, Salerno has a university, the medical school of which has some celebrity. It is also the see of an archbishop. The harbour, which is good, is protected by a mole, and defended by a castle of some strength. Population about 10,000. East Long. 14° 35′, North Lat. 40° 40′. An account of the university and medical school of Salerno, will be found in Friend's *History of Physic*, part ii.

SALEYER, or SALAYAR, an island in the eastern seas, at the south extremity of Celebes. It is forty miles long, and nearly eight broad. It is mountainous and woody, and produces millet and cotton, the best of which is made into coarse cloth. The houses are good, and the inhabitants are carried on bamboo chairs over the hills; but they have horses which they use in the plains. Population about 60,000. East Long. 120° 55′, South Lat. 5° 45′.

SALIC LAW. See FRANCE, Vol. IX. 549, col. 1.

SALFORD. See MANCHESTER, Vol. XIII. p. 302.

SALINS, a town of France in the department of the Jura. It is situated on the small river Furieuse, and is tolerably well built, and defended by two forts. A considerable trade is here carried on in wine and brandy. The principal export of the place is salt. In the vicinity is found black marble, alabaster, and quarries of jasper; but it is principally celebrated for its salt springs, of which we have already given a full account in our article FRANCE, Vol. IX. p. 691.

SALISBURY, a city of England, in Wiltshire. It is situated in a broad valley near the junction of three rivers, the Avon, the Nadder, and the Willey, the waters of which are conducted through every street by means of small brick canals, and thus not only promote health and cleanliness, but facilitate many of the processes of useful industry. The form of the town is that of an oblong square, about three-fourths of a mile each way, if Fisherton is included, and consists of five principal streets, running parallel to each other from east to west, and intersected at right angles by other five streets, so that the spaces between the streets constitute a square, which is occupied by a series of houses, with their backs looking into an area occupied by gardens, offices, &c. Most of the houses are built of brick, though some are of wood, and very irregular. The other part of the town, called the Close, which is nearly half a mile square, contains the cathedral, the episcopal palace, and the college of matrons, the deanery, the prebend's houses, and several handsome private houses held principally under the dean and chapter. Salisbury.

The cathedral, founded in 1219 by Bishop Poore. It is built in the form of a lanthorn, and consists of a nave, with two side aisles; a bold and lofty porch; a large transept, with an eastern aisle; a chapel at the east end, with an intermediate vestibule, or double aisle, terminating the choir; and a lofty tower and spire, which rise from the intersection of the great transept. The cloister, chapter-house, consistory court, and vestry, are added to the south side of the church. The spire, which is light and tapering, rises to the height of 404 feet above the level of the ground. It has declined 22⅜th inches from the perpendicular.

The interior of the building contains many interesting objects, among which are several beautiful windows of stained glass, and various splendid and handsome monuments.

This cathedral has lately undergone a thorough repair, and forms one of the most interesting public buildings in Great Britain. It is said to have as many doors as there are months, as many windows as there are days, and as many pillars as there are hours in the year.

The episcopal palace, which is near the south east corner of the cathedral, is a large and irregular building, altered and enlarged at different periods. The college of Malvius is appropriated for the reception of ten widows of clergymen of the established church. It was founded by Bishop Ward, who endowed it with L 200 per annum.

Beside the cathedral there are three parish churches, St. Martin's, consisting of a nave, two aisles, a chancel and a tower; St. Thomas's, which is a large structure, with a spacious nave, two side aisles, three chancels, a vestry room and a tower at its south-west angles, and possessing several large and curious monuments; and St. Edmund's, founded in 1268.

The town-hall or council-house stands at the south-east corner of the market place, and contains the courts of justice for the assizes and quarter sessions, &c. It is built of brick, with the angles, &c. of stone, and has a recess with a portico supported by four Doric columns. This elegant building was a present from the Earl of Radnor to the corporation.

The other public buildings of Salisbury are the infirmary, a large brick building, more commodious than elegant; the county jail which is under good regulations; the poultry cross, which is a Gothic structure, of a hexagonal form; a theatre and assembly, and concert room, the grammar school; Godolphins' school, endowed for eight young ladies; the bishop's school, for educating and clothing twenty boys and girls. The river is crossed by three bridges. Fisherton and Crane bridges are of stone, and consist each of six arches, connecting the city with the suburbs of Fisherton. Harnham bridge, which consists of ten arches uniting Salisbury with the suburb of East Harnham, is divided into two ports by a small island. The principal manufactures of Salisbury are cutlery and steel goods (particularly scissars, knives and razors,) fine flannels, woollen serges, kerseymeres, figured woollens for waistcoats, &c. The trade of the city has been greatly increased since the formation of the Salisbury canal, which communicates with the port of Southampton. The town is governed by a mayor, high steward, recorder, deputy-recorder, twenty-four aldermen, thirty common councillors, and a town clerk. The corporation of fifty-six persons elect the two members of parliament. Population in 1821, 8763; and number of houses 1680. West long. 1° 47′. north lat. 51° 4′. See Ledwich's *Antiquates Sarisburienses*, 1777; Britton's *History, &c. of the Cathedral Church of Salisbury*, 1815; Dodsworth's *Historical Account of the Episcopal see of Salisbury*, 1825; and the *Beauties of England and Wales*, vol. xv.

SALLUST, Caius Crispus Sallustius, a celebrated Roman historian, was born at Amiternum about the year 85, B. C. He was educated at Rome, but in his youth he was notorious for his profligacy and licentiousness, and he had squandered away his patrimony when he had scarcely obtained possession of it. We are informed by Marcus Varro, in a fragment preserved by Aulus Gellius, that Sallust was caught in adultery with the wife of Milo, who was the daughter of Sylla. Milo who himself made the discovery, is said to have scourged him severely, and to have detained him till he purchased his liberty by a pecuniary payment. In the year 60, B. C. he was made questor, and in 52, B. C. tribune of the people. As questor, he was admitted into the senate; but in the year 50, B. C. he was expelled by the censors on account of the immorality of his conduct. In the year 49 he was restored to the dignity of senator by Julius Cæsar, who also appointed him questor; and in 47, B. C. he was made prætor, and sent to Numidia. There he plundered the province by the most exorbitant exactions, and retired to Rome with enormous wealth, with which he purchased the house and gardens on the Quirinal hill, which still bear his name. We are informed by Eusebius that he married Terentia, the divorced wife of Cicero, and that he died at the age of fifty, or year 35, B. C. Besides his history of the conspiracy of Cataline and of the Jugurthine wars, Sallust composed a history of the Roman republic from the death of Sylla to Cataline's conspiracy, of which only a few fragments remain, and also some orations.

The best editions of his works are those of Gronovius, Ludg. Bat. 1690, of Wasse, Cantab. 1710, and of Havercamp, Amst. 1762. The works of Sallust were translated by Queen Elizabeth according to Camden, and another translation has appeared in folio, by the late Infant of Spain. One of the best translations of Sallust is by our countryman Henry Stewart, Esq. of Allanton, in one vol. 4to.

SALMON Fisheries. See Fisheries, Vol. IX. p. 363; and Ichthyology, Vol. XI. p. 706.

SALONICHI, Saloniki, anciently *Thessalonica*, is a large and handsome seaport town of European Turkey in Macedon, situated at the north end of a gulf of the same name. The town is built on the declivity of a steep hill, and is encompassed with a lofty stone wall, which ascends the hill with a triangular outline, seven miles round, and terminates in a seven-towered fortress. When approached from the sea, the domes and minarets of the mosques have a fine appearance, embosomed among cypress trees. In the interior the town is irregular, but more clean and comfortable than other Turkish towns.

The principal public building is the church of St. Sophia, which has a mosque that resembles, though on a diminished scale, that of St. Demetrius, consisting of one church erected over another, containing 1000 pillars of jasper, &c.

The trade of the place, which is second only to that of Constantinople, consists in cotton, tobacco, corn and wool, and is in the hands of Greeks, Jews, English, French, Italians, and Dutch merchants.

One of the most interesting objects of antiquity here are the remains of the ancient Hippodrome, which consist of a fine Corinthian colonnade of five pillars sustaining an entablature. The marble alto-relievos, in which the figures are as large as life, are reckoned among the finest specimens of sculpture, and are accurately represented in Stewart's atlas. The other objects of antiquity are the rotunda, on the model of the Pantheon at Rome, and two triumphal arches of Augustus and Constantius, one of which (called by some the arch of Antoninus) is almost entire. There are various blocks of marble in different parts of the town, which are used as cisterns. Several ancient fragments with inscriptions have been found without the city. Population 70,000. East long. 22° 56′. north lat. 40° 40.′

SALSETTE. See Civil Architecture, Vol. VI. p. 576. Judea, Vol. XII. p. 64, col. 2. Elephanta, Vol. VIII. p. 563.

SALT, a name which, though generally applied to all crystallized substances that are easily soluble in water, and even to those which are not soluble, is employed in common life to designate the *muriate of soda* in whatever way it is obtained. As the various chemical and mineral salts have been already fully described in our articles Chemistry and Mineralogy, we propose at present to give an account of the manufacture of *muriate of soda*, for the purposes of domestic economy, and of the various brine springs and mines, &c. of rock salt, from which it is often obtained.

Salt is obtained from three different sources.

1. From *sea water*, by evaporation, either by means of the heat of the sun, or by boiling.

2. From natural brine springs, salt lakes and rivers, by evaporation or boiling.

3. From native rock salt or muriate of soda.

1. *Manufacture of Salt from Sea Water.*

1. *By the heat of the sun.*—In warm countries where the rays of the sun possess sufficient heat to produce a rapid evaporation, salt of the very best kind is manufactured without the aid of any artificial heat. This manufacture is carried on to a great extent in France, Spain, and Portugal.

In the south of France, the land chosen as the place of manufacture is generally clayey, and not liable to be inundated. It is then surrounded by a bank or wall having inlets next the sea, which may be opened or shut by proper sluices. The land thus enclosed, is divided into compartments of from 50 to 100 acres. When the water has evaporated to such a degree that the deposition of the salt has commenced, the brine is pumped out of the compartments on a platform divided into compartments conducted by a common gutter, and elevated so as to have a free exposure to the air. As the evaporation advances more brine is pumped up till a crust of salt about three inches thick has been deposited. When the crust has become hard, it is broken into pieces and laid up in heaps in a place protected from rain. A fluid called the *bittern*, from its containing a number of the earthy bitter salts, drains from these heaps for a long time, and it requires three years exposure to drain them till the salt is esteemed perfectly good. If this draining has not been completely effected, the salt will deliquesce and have a disagreeable bitter taste. The *bittern* is in some places collected for the purpose of procuring from it sulphate of magnesia, and other substances containing magnesia. The salt procured by this process has been called *Bay Salt*, and has always been in great request for preserving animal food. For farther information on the subject, see our article FRANCE, Vol. IX. p. 691, and INDIA, Vol. XII. p. 94.

2. *By artificial heat.*—The preparation of salt by heat is adopted only in countries where fuel can be had at a very moderate price, or where the sun's heat is too weak to effect the evaporation with sufficient rapidity.

In salt works of this kind, a long and low building called a saltern, is erected near the shore. It is divided into two parts, one called the fore-house for receiving the fuel and covering the workmen; the other the pan or boiling-house, for receiving the furnace and boiler. There are two openings from the back of the furnaces into the fore-house, and from them is raised a wall to prevent the ashes from flying into the salt pans, and in that wall is a door forming a communication between the two houses. The pans, which are of an oblong form, are commonly 15 feet long, 12 feet broad, and 15 inches deep. They consist generally of plates of wrought iron united with nails, with a strong cement in the joints. The bottom of the pan is sustained by strong iron bars placed across it. The sides of the pan are sometimes made with lead, as iron is apt to oxidate. Round the sides of the pan is a walk five or six feet broad, from which the workmen draw out the salt. The roofs of the salterns are fastened with pegs of wood, as iron nails would moulder away in a few months.

Near to the saltern is a cistern either of wood, brick, or clay, and covered with a shed. This cistern is placed at such a height that the water can run out of it into the pans. Into that cistern the sea water is raised by pumping machinery from a well into which the water is conveyed by a pipe from a pool or *lump* formed in the sand.

When the sea water in the cistern has settled and deposited its mud and sand, it flows into the salt pan, beneath which, as soon as it is full, a strong fire is lighted in the furnace. When the water is lukewarm, it is in some places clarified by mixing the white of three or four eggs, with two or three gallons of sea water, and pouring the mixture into the salt pan. The blood of sheep or oxen being sometimes used for the same purpose.

As the water approaches to the boiling heat, the frothy scum or *scratch* which appears on its surface is collected into four small pans called scratch pans, one of which is at each corner of the boiler. The water now becomes perfectly clear, and after four hours boiling, crystals are seen forming on its surface. The pan is now filled to the top with fresh sea water from the cistern; the eggs or bullock's blood being used as before, and the black scum removed into the scratch pans which have been previously emptied of their white powder, a sort of calcareous earth which they contained. This second filling of the pan is boiled down like the first, and the pan is filled a third and a fourth time, and boiled in the same manner till the crystals begin to shoot. At this period of the fourth boiling, the fire is allowed to become low, so that the brine only remains, in which state it is kept for ten or twelve hours, while the salt is granulating or falling in grains or small crystals to the bottom of the pan. When the water is nearly drawn off by evaporation, the salt, which is nearly in a dry state at the bottom of the pan, is raked together into one or two heaps till the brine drains from it, when it is conveyed in barrows to the store-house. In some salt works the pans are filled up *seven* times in place of *four*, with fresh sea water, in which case the salt is drawn out only once every two days in place of every day, as in the common method. From a pan of 1300 gallons from 15 to 20 bushels of salt of 56lbs. each, are obtained every day. In the store-house the salt is laid into *drabs* or wooden troughs, with shelving bottoms, and a sliding board at the lower end, so as to allow the brine to run off. In three or four days the salt is generally quite dry.

2. *Manufacture of Salt from Brine Springs.*

Manufacture of salt from brine springs.

The method of manufacturing salt from brine springs differs very little from that of manufacturing it from sea water. In our article on CHESHIRE, Vol. VI. p. 167. we have given a brief account of the method and of the brine springs in that county; and in our article FRANCE, we have described the methods used at *Salins*.

Brine springs in America.

The following account of the American brine springs which we have abridged from Dr. Rensselaer's *Essay on Salt*, recently published, will be interesting to the reader.

Illinois.

"*Illinois* abounds with salt. The most important work is near Shawneetown, where there are now seven furnaces in operation to extract salt from the water of three wells, which used to flow on the surface at the rate of sixteen gallons per minute. These works, which have produced 200,000 bushels in a year, at present yield 150,000 bushels, worth about 70 cents on the spot. Two hundred and fifty gallons of brine yield 50lbs. of salt. Near one of the wells is a basin-shaped cavity of about 400 feet in circumference, the soil in and about which is intimately blended with fragments of earthenware. In the centre of it a well has been sunk, which affords a more concentrated brine, 110 gallons yielding 50lbs. of salt. In digging this well, the first fourteen feet were a slight earth, mixed with ashes and fragments of earthenware; the remaining fourteen were through a bed of clay, deeply coloured with oxide of iron, and containing fragments of pottery. The clay has something of the appearance of having been subjected to the action of fire. In a drain, which seems to have answered the purpose of carrying away superabundant water, is a layer of charcoal, six inches deep, and four feet below the surface. The stones in the vicinity seemed as if they had been burnt.

I should mention that charcoal is found above all the salt mines and brine springs of the Carpathian formation.

Four miles west of this point is another well, 60 feet deep; in digging, the workmen struck,

1. A bed of tenacious blue clay, 20 feet thick, at the bottom of which is a small spring of salt water.

2. A bed of similar clay 25 feet thick, and,

3. A quicksand bed of 10 feet, at the bottom of which is a large vein of salt water.

Bones of the mammoth and other animals were found in both the clay and sand.

The original reservation at these salines comprised 92,160 acres of woodland, and was transferred by the United States to the state of Illinois, which now derives from its different salines an annual revenue of about 10,000 dollars.

Missouri.

In *Missouri*, Boon's Lick, long known, furnishes the wants of the neighbouring settlements. Several furnaces are erected for the evaporation of a weak brine; 450 gallons of which yield a bushel of salt. Eighty bushels are made daily, and require three cords of wood. Compact limestone is the prevailing rock; but coal beds and strata of sandstone abound in the vicinity.

Lockhart's salt works, on the Saline River, yield 600 bushels of salt per week. The *diggings*, so often mentioned as existing here, seem to have been produced by wild cattle, resorting hither in large herds, and licking the ground for the sake of the salt contained in it. Four miles further north, on the Saline Fork of Le Mine River, is another establishment, where 180 gallons of brine produce a bushel of salt. One hundred bushels are manufactured per week, and eight men are employed in the works.

There are several small works for the manufacture of salt in other parts of this state.

Arkansas.

In *Arkansas*, independent of the saline incrustations, there are many valuable salt springs. On the Grand, or Neosho river, 50 miles above its junction with the Arkansas, in an alluvial basin, are valuable salt water springs, quite pellucid, issuing copiously from the surface in various directions. One of the springs emits fetid bubbles of sulphuretted hydrogen gas. The only well dug for salt water is about five feet deep; eighty gallons of brine produce a bushel of salt, and 120 bushels are manufactured weekly. The water is said to be so strong, that after the second boiling it is not necessary to remove the lye. The salt is pure white on the first boiling, and is said to contain none but volatile impurities. The well is in dark-coloured limestone, containing shells. No marine plants appear in the vicinity.

On the Illinois, a few miles above its junction with the Arkansas, are Bean's salt springs. They are similar to, and scarcely less productive than those on Grand River. In digging his wells, the workmen struck, about two feet from the surface, a stratum of charcoal, which affords conjectures, at least, that this locality has been known and worked by the aborigines.

On the Wachitta are springs yielding a large proportion of the muriate of soda: but I am not prepared to say exactly how many bushels are manufactured yearly; the quantity has been estimated at 50,000 bushels.

Most of the streams north of the Arkansas are said to possess salt, which might be wrought with profit; on the north side of the Arkansas the salines are connected with the coal formation; on the south they occur in red clay.

Ohio.

In *Ohio* are many salt wells; that of Zanesville, on the Muskingum, is 213 feet deep, and furnishes 80 bushels of salt daily; 95 gallons of brine give a bushel, worth on the spot 1 dol. 50 cents. In Jackson, on the Scioto, and on the Hockhocking, are several salt springs; in one a shaft has been sunk 300 feet; but the brine has proved weak, requiring 213 gallons to the bushel. There are many other springs in this state, some of which are very valuable.

In *Kentucky* the salines of the Little Sandy River are the most productive, yielding annually about 10,000 bushels. The waters, like those of Kenhawa, &c. hold in solution, besides the muriate of soda, the sulphate of soda, sulphate of lime, and a small portion of the sulphate of magnesia. Limestone and sandstone are the only rocks found in the vicinity. The brine at May's lick issues from alluvial argillaceous soil. There are other salines, yielding about 10,000 bushels.

In *Virginia* are several valuable salines; the most important are in Wythe county, and on the Grand Kenhawa River. The latter has a very strong brine, 95 gallons yielding a bushel of salt. The whole produce of this work is 30,000 bushels yearly. The rocks in the vicinity are secondary, and connected with lime, variegated sandstone, and bituminous shale. All the salt of this state is connected with gypsum.

In *Pennsylvania* the works on the Conemaugh Creek produce upwards of 100 bushels a day, which sells at nearly two dollars per bushel. After various attempts for 28 years, and sinking a shaft to the depth of 373 feet, the greater part of the way through solid rock, a good supply of brine has been procured in Susquehanna county, where excellent salt has been manufactured from it. Preparations are making to carry on the manufacture in an extensive manner.

New-York possesses inexhaustible sources of wealth in her brine springs, extending through the counties of Onondago, Cayuga, Seneca, Ontario, Niagara, Genessee, Tomkins, Wayne, and some small unwrought ones in Oneida. The most important now worked are those of Onondago, of Montezuma, (Cayuga county) and Galen, (Wayne county)

The Onondago, or Salt Lake, as it is frequently termed in its vicinity, is six miles long and two miles broad; it is supplied by the Onondago and Otisco Creeks, and emptied by the Otsego River into Lake Ontario. The lake, with its vale, is surrounded by hills of limestone containing organic remains. Abundance of gypsum has also been found associated with the salt, in the same manner as has been observed in Europe.

The most easterly point at which salt springs have been observed in New-York is about twenty-five miles west of Utica; forty miles farther west are the salt springs of Onondago. The most westerly point at which they have been as yet discovered is at Saint Katherines, in Canada.

The country or valley of the Onondago is several feet below the level of the adjacent plains, and consists of an indurated red and green clay, with their intermediate varieties. The springs rise to the surface on the borders of the lake, and even far up the creek supplying it with water. On the borders of this creek, springs of fresh and salt water rise within a few feet, and, in some instances, within a few inches of each other. The quantity of salt held in solution varies greatly in different springs, even in those that are contiguous. The strength of the brine is influenced by the temperature of the season. During the last summer, which was there a remarkably dry season, the springs continued to discharge their usual quantity of water, but it was weaker than had been before observed. Many of them are deserted on finding others of a stronger brine. The strength of these springs is comparatively very great, as will be seen by the following list of brines, and their products:

At Nantucket	350	gs. of sea water give a bushel of salt.		
Boon's Lick, (Miss.)	450	gallons of brine	do.	do.
Conemaugh, (Pen.)	300	do. - -	do.	do.
Shawneetown, (Illi.)	280	do. - -	do.	do.
Jackson, (Ohio)	213	do. - -	do.	do.
Lockhart's, (Miss.)	180	do. - -	do.	do.
Shawneetown (2d s.)	123	do. - -	do.	do.
St. Katherines (U. C.)	120	do. - -	do.	do.
Zanesville, (Ohio)	95	do. - -	do.	do.
Kenhawa, (Virg.)	95	do. - -	do.	do.
Grand River, (Ark.)	80	do. - -	do.	do.
Illinois River, (do.)	80	do. - -	do.	do.
Salina, (New-York)	45	do. - -	do.	do.

The brine of Onondago has never been accurately analysed. The following statement made some years ago by Dr. Noyes, of Hamilton College, has never been published. It is to be considered rather as an approximation. He estimates 40 gallons, or 355lbs. avoirdupois of brine to produce 56lbs. of saline extracts; of which is,[*]

	lb.	oz.
Pure muriate of soda, - -	51	00
Carb. of lime coloured by oxide of iron,	0	6½
Sulphate of lime, - -	2	4
Muriate of lime, - - -	1	12½
Muriate of magnesia, perhaps		

It is to be remarked, that in this statement is not mentioned sulphate of soda, which is most probably present in very considerable quantity.

The salt springs and the surrounding country belong to the state; but permission is given to any person, under certain limitations, to erect works and extract salt, upon paying into the treasury a duty of 12½ cents per bushel of 56lbs. The leasing of the salt lots has been regulated by the legislature.

Under the head of Onondago are usually comprised three villages, and their works, viz.

Salina, where there are	50	furnaces or blocks.
Liverpool,	30	do.
Geddesburgh,	13	do.
Total	83	

averaging each fourteen kettles, and each of them calculated to produce forty bushels a day, amounting to 3320 bushels, or 664 barrels, at the rate of more than 1,000,000 bushels annually; which has a ready sale on the spot at from 1 dol. 75 cts. to 1 dol. 81 cts. per barrel; making one day's manufacture 1162 dollars.

When the western canal is opened, it is supposed the salt from these works can be afforded at Albany, at 37½ cents per bushel. While the canal was only partially opened, there were cleared at Syracuse, from April 18th to September 11th, 34,793 barrels, or 178 990 bushels of salt.

The quantity of salt inspected at these works, during the year ending August 6th, 1823, viz.

				Revenue.
Aug. 7, to Nov. 5, 1822.	145,626,	at 12½ cts.	per bush.	18,203 25 dol.
Nov. 6, May 20, 1823,	300.862,	do.	do.	37.607 75
May 21, Aug. 5,	159,975,	do.	do.	19,996 89
Total,	606,463			75,807 89 dol.

The revenue from these works is yearly augmenting. In 1800 the quantity of salt manufactured amounted to 42,754 bushels. In 1814 the superintendant reported 295,215 bushels of salt manufactured and inspected at the works of Onondago. The state duty was three cents per bushel, and the nett profit, after paying all expenses, was 7303 dollars 87 cents, to the government, of which 5200 dollars was expended upon roads.

The springs now used are all situate on the marshy edge of the lake. The one first worked is said to have been at Green's Point, between Liverpool and Salina. A strong wooden curb is settled down from six to ten feet, and, until recently, the water was pumped out by hand. The principal source whence all the works are now supplied, is termed the Horse Spring, and is furnished with a powerful forcing pump, raising the water seventy feet above the lake, and giving 120,000 gallons per twenty-four hours. The brine is conveyed by wooden pipes to the distance of two miles, supplying the villages of Geddesburgh and Syracuse. The supply of water, and, of course, the works, may be increased indefinitely. The forcing pump belongs to individuals, who receive two mills per bushels on all salt manufactured at the works.

There are three kinds of salt manufactured at these villages; the common fine, the rectified fine, and the coarse salt. The common fine is made in the greatest quantity. The process employed seems to be very slovenly, and until lately many complaints were made of its quality. Legislative interference has abolished the causes of these murmurings, and introduced a better system of manufacture. The method now employed does not differ materially from that used in other countries. From twelve to sixteen kettles, holding from ninety to one hundred gallons each, are firmly set in brick work over a furnace. The form and size might be materially improved: they are certainly much deeper than necessary. The foreign substances, (or bittern, as it is technically called,) is first extracted, and then the salt. The only mode they appear to possess of determining when the bittern is extricated from the brine, seems to be by observing how much of the water is evaporated. They then dip it out, and by observing a certain point to which the brine is boiled away, commence taking out the salt, which is thrown into a basket, suffered to drain for a few minutes, and is then fit for use. It may be readily imagined, from this rude process, that the salt cannot be very pure. It contains much muriate of lime, which adds to its whiteness, while its destroys its purity. It is thereby rendered in a great measure unfit for its most important use, *i. e.* preserving provisions. It is estimated that each kettle will produce five bushels every twenty-four hours, requiring two cords of wood for the furnace during that time.

The refined, or rectified salt, is made in small quantities here; it is intended for the table, and comes to this market in small boxes and baskets of from ¼ to 8lbs. each. It is equal to the finest imported.

The manufacture of coarse salt has lately been commenced at Syracuse, in the vicinity of the other works. It is produced by solar evaporation alone. The brine is poured into large shallow vats, furnished with covers to protect them from the rain. The marsh mud and bittern being precipitated, the brine receives the technical name of pickle, which is drawn off into vats, and the deposit formed. The precise point at which the brine is converted into pickle, is determined by the appearance of cubical crystals of salt floating on the surface. Very little has as yet been manufactured; but the proprietors are now erecting works, where it is intended to produce annually 100,000 bushels; and from the known enterprise of the gentlemen most largely concerned, there is no probability of a miscalculation.

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[*] It is a remarkable fact ascertained by M. Herrmann, that the composition of brine springs changes considerably. In 1798, the brine from Halle, in Prussia, contained muriate of lime and muriate of magnesia in the proportion of 7 to 1; but recently the muriate of magnesia was nearly double the muriate of lime. In 1794, a certain quantity of the brine of Schonebeck contained 6000 cwt. of sulphate of soda; but in 1823, the same quantity of brine contained 37,500 cwt. See Dr. Brewster's *Edinburgh Journal of Science*, vol. i. p. 384.

It is the general belief at Salina, that great masses of salt exist, and may be discovered near to the surface; and the legislature have granted certain powers to persons searching for the mineral, securing to them certain valuable privileges on the successful termination of their search. With the aid of such strong stimulus, added to the usual hope of gain, we may hope that fossil salt will be discovered, as it doubtless does exist in the vicinity, although perhaps at a considerable depth. Unless it should prove very pure, however, it would be necessary to redissolve it to obtain the salt of commerce. In which case it is at least problematical if it would add much to the value of the manufacture.

From the springs in the town of Salina, (including the villages of Salina, Syracuse, Liverpool, and Geddesburgh,) it is calculated that at least three millions of bushels could be made annually, should the demand justify it, yielding the state a yearly revenue of 375,000 dollars.

Montezuma, in the county of Cayuga, embraces salt springs of great value. The works are owned by a company engaged in the manufacture of refined or rectified salt. The following Table shows the quantity of salt made, the revenue to the state, and the expense:

Inspected, from	Bushels.	Revenue.		Com. to Supdnt. at 7 1-2 per cent.	
		Dol.	Cts.	Dol.	Cts.
Aug. 1 to Oct. 31, 1822,	3332	416	50	31	23
Oct. 31, 1822, to Jan. 31, 1823,	5031½	628	93	47	16
Jan. 31 to April 30, 1823,	3207½	400	93	30	06
April 30 to July 31, 1823,	2726	340	75	25	55
	14,297	1787	11	134	00

The salt water used at Montezuma, was obtained by the Indians by digging small holes in the ground a foot or two in depth, in the marsh at the foot of the ridge upon which the village now stands. The water came through small strata of quicksand. Afterwards wells were sunk by the whites to various depths, from fourteen to fifty feet, from which water of the same quality with that which was first discovered was taken in sufficient quantities to make considerable salt. The water, however, was weak, yielding about eight ounces to the gallon.

About 1807, General John Swartwout began to manufacture salt from salt water, discovered in a branch of the Seneca River, since called Salt Creek, at the depth of about eight or twelve feet from the surface. This water was of a quality like that first used; the fresh water was partially excluded by means of a curb.

In the year 1810, under the direction of the Cayuga Manufacturing Company, a well was sunk on the west side of the ridge of ground upon which the village now stands, to the depth of something more than one hundred feet. In sinking this well three separate springs of water were discovered: the first, like that which had been previously used, about ten feet from the surface. Then succeeded a stratum of fine blue clay, five or six feet in depth; then a stratum of hard pan, with occasionally some gravel, about thirty-five feet in depth; then a thin stratum of quicksand, containing a little weak brine, having about ten ounces to the gallon; then succeeded thin irregular strata of sand and clay, with some water, until they reached to the distance of a hundred feet, where they found the great fountain of water, which came in through a body of quicksand. This water, when pure and unmixed with the upper veins, produced about twenty ounces to the gallon. Another well was sunk on the east side of the ridge, and the great fountain was found at the depth of eighty feet. The geological appearances were like those in the first well. Another well is partly completed in this place: it is now sunk to about the depth of fifty feet, and the geological appearances are much the same as in the other wells, except that the upper vein of water is more abundant than in the other wells, and the sand deeper.

The foreign matter is essentially the same as at Salina.

The strength of the water now used from our wells, compared with that of Salina, is about as nine to twelve.

The amount manufactured at these works last year was between 16 and 20,000 bushels, 1000 of which was made by solar evaporation. No kettles are used, but large pans of wrought iron, which were made in Liverpool, England. Only six of these were in operation last year; more have heretofore been in operation. Twelve or fourteen will be in operation next year.

No rock salt has ever been found here.

The hills and ridges run almost due north and south, and the soil is generally gravelly, the pebbles being round and smooth.

In 1810, the county of Cayuga furnished nearly 60,000 bushels of salt. How much is made at present I have not been able to ascertain.

In the county of Wayne, the town of Galen manufactured about 150 bushels daily in 1810, making an average of about 50,000 yearly. There are several other valuable salt springs in this county.

Genesee county contains several valuable salines: but they are not extensively wrought, yielding only a few thousand bushels a year.

Seneca county enjoys fine salt springs in Wolcott and the neighbouring towns; but they are not productive at present.

The salt springs in the counties of Ontario, Niagara, Tompkins, and Oneida, have not been used thus far in the production of salt. They are individually of great worth to the proprietors and to the state, and will soon be made productive.

The strength of our salt springs is, upon an average, greater than those in Europe, though it is a matter of no practical moment at the present day. It should be remembered, however, that many European brine springs have been estimated too highly. It has been repeatedly said, for instance, that the brine springs of Barton and Northwich, in England, yield six ounces of salt to the pound of brine, or more than one-fourth part pure salt. Now, experiment proves, according to the minute investigations of the Bishop of Landaff, that this cannot be true; for allowing that sixteen ounces of water can hold six ounces of salt in solution, and no more, it follows that no brine spring can yield six ounces of salt from a pint of brine, because sixteen ounces of water with six ounces of salt would be a saturated brine of twenty-two ounces: therefore, if twenty-two ounces of brine yield six ounces of salt, sixteen ounces of brine can yield only four and four-elevenths ounces of salt. So that the strongest brine can yield very little more than one-fourth part its weight of salt. Cheshire salt brine gives twenty-two per cent.; in one remarkable case it gave twenty-five per cent.; and once twenty-six per cent. of salt.

In Switzerland, from thirteen to fourteen per cent. is the usual strength of the salt brine springs. In France, eleven per cent. is the average.

Most, or perhaps all our brine springs are original or primary sources. Sources are of two kinds:

1. Those which rise immediately over the bed impregnating the water, or from a stratum immediately connected with it, though perhaps at some distance from the fossil.

2. Those which rise from a collection of salt water made in a stratum not immediately connected with the impregnating mineral.

It is not essential that a spring should rise immediately over a mineral charging its waters; because, after being impregnated, it may flow over an impervious stratum, as grauwacke, for example, and rise at a very considerable distance pure and valuable brine; it is still a primary source. But a body of water flowing over salt, or any other mineral, and oozing through different strata, until it reaches one that it cannot percolate, and then it follows it till, from some cause, (in what manner it matters not,) it rises to day, is a secondary source; because it neither rises over the mineral, or any stratum immediately connected with it.

In mountainous countries, particularly, this is a subject of much importance, as the hopes of success are founded upon permanent sources, which the secondary never are, being liable to be diverted from their present channels by slight obstacles, and to rise in other places. Some of the salines in Switzerland are worked on this principle of sources, and it often happens that a vein of water is intercepted, and leaves the brine spring dry.

At Halle, in Germany, and at many other places, mines are worked by cutting parallel galleries in the parent rock, and forming dykes, to turn water into them, where it remains until saturated. It is then drawn off and evaporated. In most cases judgment and experience are necessary in drawing water from salt pits, whether natural or artificial, where it reposes immediately on the salt. As the stratum of saturated water next the salt has an increased specific gravity, and will remain at the bottom, preventing the great volume of water from coming in contact with the mineral to be saturated in its turn, it is necessary to keep the water in motion. Experience has proved the great utility of this expedient, which will saturate the water in a much more expeditious and effectual manner than by allowing it to remain at rest."

3. *Rock Salt Mines.*

Native rock salt, or fossil salt, is found in most countries of Europe, and also in every quarter of the globe.

The ancients seem to have been acquainted with rock salt. It is probable that the columns of fossil glass, in which Herodotus informs us the Abyssinians enclosed their mummies, were masses of rock salt which existed in the country. Herodotus likewise informs us, that the Lybians built their houses with it; and Pliny states that the Arabians did the same, cementing the whole by sprinkling water upon it.

In England, beds of from twenty to thirty yards thick are found in Cheshire, and which we have generally described under that article, Vol. VI. p. 167.

In France, native rock salt has been recently (in 1819) discovered at Vic, in the department of Meurthe, and also in the department of the Vosges, associated with gypsum, clay, and sandstone. At Vic there were six distinct strata of very fine rock salt from three to fourteen inches, and at a depth of from 65 to 104 metres. Such, however, is the condition of France, that no use has yet been made of this mineral treasure.*

Spain. Spain possesses the celebrated rock salt mountain at Cordova, in Catalonia, and it is said it has also been lately discovered in the Pyrenees. At Cordova, about eight-tenths of the mountain, which is 300 feet high, consists of rock salt. The surface of the mountain is destitute of vegetation, and the mountain itself is composed of vertical and generally parallel beds of thick salt, clay and gypsum alternating with each other. The salt is sometimes transparent, but most frequently it occurs in translucent masses, consisting of small greyish white, or reddish granular concretions. The country around this mountain consists of micaceous sandstone, argillaceous slate, and compact limestone.

This formation seems to be an independent one, in a valley a league in circumference, the surface of which is covered with vegetable soil. At one end of it is a promontory of red salt 660 feet high, without crevices, chasms, or strata. It is said to be about a league in circumference, and equal in height to the surrounding mountains.

At La Mancha, in Spain, there is a similar mass of salt 210 feet in diameter, which is mixed with and covered by sulphate of lime, including crystals of red quartz.

Near the river Ebro, there is a chain of hills stretching from east to west, and consisting of salt, sulphate of lime, and limestone.

Germany. In Germany there are many masses of rock salt, namely, in Upper Austria, Styria, Bavaria,† Wurtemberg, Salzburg, and the Tyrol. The salt mines of the Tyrol are situated in a mountain, and they are wrought by excavating galleries, and introducing fresh water, which is allowed to remain till it is saturated.

Hungary and Poland. In Hungary and Poland, there seems to be an immense deposite of rock salt on both sides of the Carpathian mountains. An account of the Hungarian masses will be found under our article HUNGARY, Vol. XI. p. 357, and of those of Wielitska, near Cracow, in Poland, under our article POLAND, Vol. XVI. p. 735.

Near Ockna, in Moldavia, there is a mountain of rock salt, which in many places is not even covered with the soil.

In Transylvania, the bottom and sides of the valley of Paraid, consist of solid salt exposed to view, and it rises in several precipices to the height of more than 200 feet.

In Italy rock salt is found at Altamonte, in Calabria.

Turkey. In Caramania, in Asiatic Turkey, the rock salt is so hard, and the air so dry, that, we are informed by Chardin, it is employed in the construction of buildings.

The whole island of Ormuz, in the Persian Gulf, is said to be a solid mass of fossil salt.

Caubul. In Caubul, the rock salt rises in a cliff more than 100 feet above the river. It is hard, transparent, and almost pure, and the road is cut through it. In some places it is streaked of a blood red colour, like the earth in the neighbourhood.

Africa. In Africa, rock salt is abundantly distributed. It is found in Tunis and Algiers, and in the mountains which bound the desert of Lybia on the north, is an immense plain covered with common salt.

Near Jibbel Had-deffa, in Tunis, there is an entire mountain of salt, situated at the eastern extremity of the lake of St. Mark. The salt is of a reddish or purple colour, and is as hard as stone. A portion of it is washed down by the dews, and becomes as white as snow, losing the sharp bitterness of the parent rock.

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* Simond's *Switzerland*, vol. i. p. 18.

† See BAVARIA, Vol. III. p. 353.

In the mountains of Levotaiah and Miniss, the salt is of a grey bluish colour, and very agreeable to the palate. The salt from the lake of St. Mark is of the same quality, and the principal stratum of it resembles a tesselated pavement, composed of various small cubes of common salt.

On both sides of the Atlas mountains it occurs in great quantities. M. Hornemann discovered a plain on a limestone range, which consisted of a mass of rock salt, extending so far in length that no eye could reach its termination, and at the same time several miles in width. In Abyssinia, there is a plain of salt four days journey across.

American salt formation.

The American salt formation, according to Dr. Van Rensselaer, extends over the continent from the Alleghany mountains to the North Pacific, between 31° and 45° of north latitude. In this immense tract rock salt has been occasionally found; but the extent of the formation is inferred from the brine springs.

In California, rock salt is found in large quantities.

On the plains east of the Rocky Mountains, it is found in incrustations covering lands of some extent.

The immediate valley of the Canadian river is bounded by precipices of red sand rock, forming the river Bluffs. In the valley between these, incrustations of nearly pure salt is found covering the surface to a great extent like thin ice, and giving it the appearance of a coating of snow when seen at a distance.

In South America the salt mines are numerous. There are many in Peru situated at the height of 10,000 feet, and some of them are near Potosi, where the salt is usually of a violet colour, and occurring in hard, solid, and continuous rocks. It also occurs in Mexico, Chili, New Granada, &c. It is found in immense blocks in the muriatiferous clay, lying above sandstone, at Punta Araya, on the Cordilleras; and at the bottom of the lake Pennon Blanco, in Mexico, there is a bed of clay containing about thirteen per cent. of rock salt. The salt lake of Pennon Blanco yields annually 250,000 fanegas of unpurified salt of 400 lbs. each.

In North America, salt does not seem to have been found in the state of rock. It is found, however, in incrustations of considerable thickness and solidity on the soil of plains and prairies near the sources of the Arkansas river; and at Fort Osage, there is an extensive plain 280 miles south-west from the fort, which, in dry and hot weather, is covered with an incrustation of clear white salt, from two to six inches thick. This saline is about thirty miles in circumference, and is in many places covered with drift wood.

Having thus given an account of the principal localities of rock salt, we shall conclude this part of the subject with some observations on the origin of this mineral, for which we have been indebted to Dr. Van Rensselaer.

"As to the origin of rock salt, the most satisfactory hypothesis is the supposition of its being deposited from sea; or by the desiccation of salt lakes formerly covering our present continents. The objection that the composition of rock salt is more pure than that from the sea water, which contains also sulphate and muriate of magnesia, sulphate and muriate of lime, and sulphate of soda, is invalidated by the recollection that whatever impurities may exist in sea water, still, if the process of evaporation be conducted very slowly, the crystals are nearly pure. In some places the process is conducted so well, as at Lymington, in England, where it takes twelve days, that from the most impure, or mother water, it still contains only twelve parts in the 1000, or little more than one per cent. of impurities. If, then, the desiccation of lakes, or basins filled with salt water, be very slow, as it must be when the process is to be finished by natural evaporation, the muriate of soda would be crystallized before the other salts, which being more deliquescent, might be separated and washed away. In the same way, the gypsum that usually accompanies salt might be deposited, and being nearly insoluble would remain.

That lakes of salt and fresh water have once covered much land, is not to be doubted in the face of so many incontrovertible facts as can be brought forward. Our own day offers proofs of the changes that are constantly taking place on the earth's surface, by the desiccation of lakes, in whatever manner accomplished. Our own country, with our immense lakes or inland seas, will one day exhibit a different picture to the eye of the geographer, the painter, and the geologist, from what it offers at present. If, as may readily be supposed, a vast lake once covered that portion of our country to the west of the Alleghany mountains, and which was eventually drawn off by the outlets cut by the St. Lawrence and the Hudson, through the Highlands of Montreal and New York, we have an idea upon a grand scale of what will, at some future day, be the effect of draining our northern lakes. The falls of Niagara, gradually receding to the outlet of Erie, will eventually discharge the waters of the great lake and its tributary streams into Ontario, to dash rapidly down the St. Lawrence to the Atlantic, or to be distributed slowly as from a reservoir.

The bed of Erie will then form an extensive plain or valley, bounded by the distant hills, and watered by a small lake or river, which will give passage to the St. Clair and Huron, and form a prolonged channel to the river Detroit. Here the geologists of future periods will find a fresh water formation in successive strata upon the limestone bed. These strata will probably be a coarse sandstone with argillaceous marl, containing fresh water shells; among others, some of the Uniones, so well described by Mr. Barnes. These will be sedimentary fresh water formations, produced almost entirely by mechanical means, *i. e.* the deposition of earthy matters, coarse or fine, enveloping organized bodies. They may have a different structure from other fresh water formations. The layers may be distinct and numerous, with a coarse sandy grain, having the usual perforations to manifest the extrication of gas from the limestone beneath. It may be similar to the fresh water formatious of Paris and Rome; or may resemble the *molasse* of Switzerland.

But we need not look either into ancient records, or into futurity, to know that both salt and fresh water lakes have covered much of the earth; and that they have, and do, and, from analogy, will form deposits of soils and minerals. Salt lakes still exist in many places. The zout pans, in the south of Africa, are salt lakes furnishing that country with salt. Some of them are more famous than others; but all are situate on a plain, at a considerable elevation above the sea, none being less than one hundred feet above it. A brief account of one will suffice for the rest. The greatest part of the bottom of the lake is covered with one continued body of salt, like a sheet of ice, the crystals so united as to form one solid body as hard as rock. The shore is similar to the sandy beach of the sea coast, covered with sandstone and quartzose pebbles. At this beach begins a thin crust of salt, increasing in thickness and solidity as it advances to the middle of the lake. Near its margin, where it is four or five inches thick, the salt is taken out with pick-axes, and is fit for use. The thickness of this bed at the middle has never been ascertained, as the waters do not subside. In endeavouring to account for the accumulation of pure crystallized salt at the bottom of this lake, it might be considered an explanation sufficiently satisfactory to say, the waters on the south coast of Africa contain a high proportion of salt. During the strong south-east winds of summer, the sea spray is carried a great distance into the country, in the shape of thick mist. The powerful and combined effects of the dry wind and sun carry on a rapid evaporation of the aqueous part of the mist, and, of course, a disengagement of the saline particles, which fall on the ground and the foliage of the shrubbery. When the rains commence, they are dissolved and carried in solution to the salt pan, towards which the country on every side inclines.

The quantity of salt thus taken from the sea, and borne into the country, is so very great, that at the distance of many miles from the coast, the air is perceptibly saline when walking against it. The atmosphere is obscure, and objects at a short distance are not seen. These winds last for nearly two-thirds of the whole year, and it is easy to conceive, that in the lapse of ages an immense accumulation of salt can thus be formed. This lake is in red sandstone, and the salt is in some places tinged with the red colour of the oxide of iron.

In Mexico, the salt lake of Pennon Blanco, already noticed, yields annually 250,000 fanegas of unpurified salt of 400 lbs. each, making an aggregate of about 1,785,714 bushels.

Turks Islands are celebrated for salt ponds, which in some years have yielded more than 30,000 tons of salt for exportation.

The occurrence of rock salt deep under the surface of the earth, or high above the level of the sea, forms no objection to its being a deposit from water, since all geologists allow, and undoubted facts prove, that the ocean once covered all the continents now known. Whether the earth has been elevated above the sea, or the sea depressed beneath the level of the earth, the valleys must have been filled with salt water, which, upon evaporation, deposited salt. At Cardona, and other places, it seems to have been deposited in the red sandstone, or rather to be enveloped by it. Some of these valleys occur at great elevation: thus the one in which is deposited the salt mine of Tyrol is 5000 feet above the level of the sea. In the deserts of Peru is one 10,000 feet, according to Ulloa, above the sea. Others again are at various depths beneath the surface; thus, one in England is 735 feet deep, being 420 feet beneath the level of the ocean.

The difficulty which has been supposed to exist in accounting for the formation of strata under which rock salt is found, is in a great measure obviated by the organic remains found in them; proving that each stratum was once the uppermost and last formed on the globe, and was in turn covered by others at different and distant periods. In the same way there are many strata occasionally covering coal and beds of shale, abounding in vegetable impressions.

The situation of salt in beds or springs at the foot of mountain chains, as already mentioned, may in some measure tend to illustrate its formation, as it is probable that they (the mountain chains) were once the boundaries of inland seas or lakes, when our continents and oceans bore a different relative position from what they now exhibit."*

4. *On the Uses of Salt.*

Uses of salt.

The uses of salt are numerous and important. It is used in the following articles of manufacture.

"Sal ammoniac, says Dr. Van Rensselaer, or muriate of ammonia, is made in abundance from common salt, which contains 51 per cent. of muriatic acid.

The manufacture of this article was abandoned in England, in consequence of the heavy duty of £30 per ton laid on salt. In consequence, however, of bittern from the salt works being allowed in Scotland for the manufacture, the price has been reduced nearly one half, and before the duty was taken off, was sold at £120 per ton.

In the manufacture of glass, salt is largely employed; soda, which is procured from common salt, is used for plate glass; potash for flint glass, and common salt, mixed with kelp, for crown-glass.

Oxy-muriate of lime, and other oxy-muriatic salts employed in bleaching, are made from salt, and consume a large quantity of it in the manufacture.

Spirit of salt, or muriatic acid, requires large quantities of salt. Mr. Parkes consumed twenty tons yearly in the production of it; and at least 1000 tons are used for this purpose in England every year. It is used in a variety of processes in dyeing and calico printing.

Glauber's salt is made from what remains in the stills after the distillation of muriatic acid. This residuum was formerly thrown away, until a person employed it in making Glauber's salt.

Epsom salt is produced from salt, or the evaporation of sea water. The brine, which yields 100 tons of salt, gives from four to five tons of this valuable article. Dr. Henry, has discovered a process of preparing it from magnesian limestone, and has reduced the price one half. It can be made however still cheaper from sea water. Magnesia is made from salt brine, or sea water.

Crystallized soda is also made from common salt; and as the duty is taken off salt, the importation of American or Russian pot and pearl ashes may be superseded, and 10,000 tons may be used annually in Great Britain. Several hundred tons are used in washing alone.

Barilla of an excellent quality is made from salt. In the manufacture of hard soap, salt is a necessary ingredient.

Corrosive sublimate is always made from common salt. It is not only a medicine, but is used extensively in calico printing, and in other arts. Salt is always used in making corrosive sublimate: every 6 lbs. of quicksilver require 12 lbs. of salt; and in making calomel, every 9 lbs. of quicksilver require 16 lbs. of corrosive sublimate.

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* Some curious discoveries respecting the consolidation of sand by the fumes of salt or of brine, have very recently been made by Sir James Hall, Bart. A copious abstract of his very curious paper on this subject, will be found in Dr. Brewster's *Journal of Science*, vol. iii. page 1.

Patent yellow is also prepared from common salt.

In the fisheries, in salting provisions for the sea service, and for exportation, salt is largely employed. For these purposes, however, it should contain no muriate of magnesia, which deliquesces and dissolves the salt. It is always present when salt is made by a rapid evaporation.

Butchers, morocco dressers, and skinners, employ it in large quantities.

Housekeepers employ salt in quantities, of which no accurate estimate can be made. By inquiring of the best bakers in this city, (New York) I find that upon an average throughout the year, 3¼ lbs. of salt are required for two barrels of flour, or half a pound of salt to every bushel of flour. Hence it may be presumed, that every adult consumes an ounce of salt per week, or three and a quarter pounds per annum in bread only. Thus, then, ten millions of people (our population) consume yearly in bread 32,500,000 lbs. or 14,500 tons, or 580,360 bushels of salt. In England double this quantity would be consumed, since there a pound of salt is used to every bushel of flour.

Farmers use great quantities in making butter and cheese, and for steeping wheat to prevent smut; for which purpose it proved the best in a trial of fourteen substances, simple and compound. Bishop Watson says, that in Northwich alone 3000 tons of salt were annually sold to the farmers of that district.

In glazing earthen ware much salt is consumed, and it is far preferable to the preparations of lead, which are liable to be dissolved by vinegar, and eaten. In England the manufacturers of earthen ware sometimes used to pay one-twelfth of the real amount of their sales for salt.

Salt is likewise employed by iron founders in metallic cements, and in rendering bar iron very malleable. It is used by whitesmiths and cutlers in case-hardening, in tempering files, and some other edge tools; mixed with other substances for reducing metallic ores, assaying minerals, and rendering metals fusible, by the refiners of silver, and to prevent the oxidizement of some metals. It is used to moderate the flame of combustible bodies; and is extensively employed by the philosophical and manufacturing chemist, and by the druggist for a variety of pharmaceutical purposes.

In horticulture, salt it much used, particularly in England, where its merits are better appreciated than with us. It prevents the depredations of insects on fruit trees, and when properly applied, protects them from the honey dew. Persons ambitious of having good cyder orchards are advised to dig a small trench a few yards from each tree, and place within it a few pounds of salt, which, by the rains, &c. is gradually conveyed to the roots, and produces the most desirable effects.

In agriculture, I regret to say, salt has not met the attention it merits in this country. In after years, perhaps, when soil becomes more valuable, we too may be driven, as they now are in many parts of Europe, to seek means of rendering bad land productive, and literally leave no stone unturned that can tend to accomplish the object.

In Europe much has been said and written to prove and to disprove the utility of salt as a manure. Without entering at all into their ideas of the modus operandi, we may judge from the effects of experiment. I may say, however, that it has been supposed beneficial in small quantities, by its tendency to promote putrefaction; and injurious in large proportion, because it then exerts its antiseptic powers. It has been supposed of benefit by destroying snails, grubs, and other animals in the ground.

It is observed by Dr. Darwin, that as it is a stimulus which possesses no nourishment, but may excite the vegetable absorbent vessels into greater action than usual, it may, in a certain quantity, increase their growth, by taking up more nourishment in a given time, and performing their circulations and secretions with greater energy. In a greater quantity its stimulus may be so great as to act as an immediate poison on vegetables, and destroy the motions of the vessels by exhausting their irritability.

The reports of experimenters on the use of salt, as a manure, have been as different as the soils on which their trials were made; owing, in some measure, to causes which can never be foreseen or controlled, and on which agricultural experiment so generally depends.

In soils of ferruginous sand, brought to a proper consistence by mud, or clay, or marl, salt has been found to exert effects superior to eight out of ten of the best manures. A quantity of ground was prepared, and divided into beds of forty yards in length, by one in breadth. The beds were then sowed and manured by the following substances, in the quantities mentioned:

1. No manure.
2. Salt, half a peck.
3. Lime, one bushel.
4. Soot, one peck.
5. Wood ashes, two pecks.
6. Saw dust, three bushels.
7. Malt dust, two pecks.
8. Peat, three bushels.
9. Decayed leaves, three bushels.
10. Fresh dung, three bushels.
11. Chandler's graves, 9 lbs.

With the exception of chandler's graves, salt was decidedly the best of those used. On a trial of compounds, the combination of salt and soot was the best. The substances were mixed in the following order, and the same quantity of each employed as when used singly;

1. Salt and lime.
2. Salt, lime, and sulphuric acid.
3. Salt, lime, and peat.
4. Salt, lime, and dung.
5. Salt, lime, gypsum, and peat.
6. Salt and soot.
7. Salt and wood ashes.
8. Salt and saw dust.
9. Salt and malt dust.
10. Salt and peat.
11. Salt, peat, and bone dust.
12. Salt and decayed leaves.
13. Salt and pearl ashes.
14. Salt and chandler's graves.

Perhaps this superiority may be accounted for by the quality of saline substances to attract moisture from the air; for those beds where salt had been used were visibly and palpably moister than the rest, even for weeks after the salt had been applied; and the appearance continued until rain fell, when, of course, the distinction ceased. In several instances the crop of the land failed altogether, except on the part where salt was applied.

It is to be remarked that these observations apply particularly to what are called ferruginous sandy soils; so that they are adapted, in a good measure, to some part of our salt formation; and much of the land lying between the Council Bluffs, and the Rocky Mountains, a band running parallel to the river Platte, is such, perhaps, as after ages may improve by the use of the salt abounding in the rivers in that region. It will be long before the population of that section of the union will be sufficiently numerous to make it necessary to think of it. It will be at a period when all our national resources are brought into action.

In Hindostan and China all the land on the coast is regularly treated with sea water, and they depend solely on this management for the increase and goodness of their rice crops. In Poland salt is extensively used in the tillage of land.

Many valuable communications on the use of salt, as a manure, have been made to the British Board of Agriculture. I may be allowed to mention two further experiments made on this subject.

To show the effects and advantages of salt properly applied to vegetables, the gardener of Lord R. Manners made the following experiment, in an extreme dry summer, upon a bare piece of pasture land, out of which the cattle were all taken for want of grass. He marked off four places, each of which was watered for nine successive nights, in the following manner: the first with one gallon of spring water; the second with a gallon of the same water, containing an ounce of common salt; the third with the same quantity of water, and two ounces of salt; and the fourth with the same quantity of water, and three ounces of salt, which gave the following effects:

The grass in the second place grew more abundant, and of a darker green than that in the first; in the third place it grew only by spots, for part of it was killed where the greatest quantity of water fell; and the fourth was quite brown for a greater compass than the third: by which it appears that an ounce of salt in a gallon of water had a better effect than the water alone; and that three ounces of salt mixed in a gallon of water was more than the grass could immediately receive; but the fourth place, in the ensuing spring, was the most fertile of them all.

The other experiment I shall notice is related by Dr. Holland, well known by his agricultural survey of Cheshire.

After draining a piece of sour rushy ground about the middle of October, he ordered some refuse salt to be spread upon a part of the land, at the rate of eight bushels to the acre, and in another part sixteen bushels. In a short time the vegetation disappeared totally, and during the month of April following not a blade of grass was to be seen. In the latter end of the month of May a most flourishing crop of rich grass made its appearance on that part where the eight bushels had been laid. In the month of July the other portion produced a still stronger crop; the cattle were remarkably fond of it; and during the whole of the ensuing winter, (which is ten or twelve years since,) and to this day, the land retained, and yet exhibits, a superior verdure to the neighbouring closes.

In the memoirs of the Royal Academy of Sciences at Paris are several papers showing the great advantages resulting from the use of salt as a manure, in improving land, and increasing the number of cattle. It is there asserted that more than the usual quantity of working cattle on a farm gives a double advantage, by doing the work in season, and enriching more land by their additional manure. The difficulty of maintaining this additional number of cattle without increasing the expense, is obviated by the use of salt. To prove which it is advanced:

1. That salt given with the food of cattle augments its nourishment.

2. That in proportion to the quantity of salt eaten by cattle, the effects of the augmentation are perceived.

3. That no ill consequences follow its use, even when given without stint.

These propositions are supported by unquestionable evidence, and the trials of very many persons.

Crau, in the jurisdiction of Arles, in the county of Provence, France, has an extent of six leagues by three, the whole surface of which is covered with small rough stones, and not a tree or bush is to be seen upon the whole district, except a very few scattered on the border; yet on this apparently barren spot, by the free use of salt, more numerous flocks of sheep are bred and reared than upon any other common of equal extent in the kingdom; and what is not less remarkable, the sheep are healthier, hardier, and endure the severity of the winter with less loss, though they have fewer sheep cotes for covering, than those fed and bred in more luxuriant pastures, and that have the advantage of convenient shelter. Add to this, that the wool of the flocks bred and brought up in the Crau is not only the finest, but bears the highest price of any in France. It is concluded, that these surprising effects are consequent upon the unlimited use of salt: for it frequently happens that the Crau is so parched up in summer, that the animals are obliged to turn up the very stones to get the few blades of grass that grow round them, and yet none perish for want of food. Allowing every excellence than can possibly be supposed inherent in the herbage, yet the quantity of it is so small, that without the abundant use of salt, a fourth part of the sheep kept in the Crau could not subsist on it.

The second proposition can be proved by an experiment, which every farmer can make, simply by giving salt to one half of his cattle, and none to the other half: in less than a month there will be a perceptible difference in the appearance of the animals, in the sleekness of their coats, in their growth, and in their strength and firmness of labour; and these effects will be produced by little more than half their usual food.

The third proposition is supported by the practice in Arles, where the cattle have as much salt as they can eat, and none are so healthy, or thrive so fast, as those that eat most of it.

In Spain, where the finest wool in the world is produced, large quantities of salt are given to the sheep; to which they attribute, in a great measure, the fineness of the wool.

In England a thousand sheep consume at the rate of a ton of salt annually. It is supposed to destroy the fasciola hepatica, or fluke worm.

It has long been a practice in our country to give salt to horses, and to milch cows. About 1,000,000 tons are given to animals in England."

We shall now conclude this article with an account of the results obtained by Dr. Henry of Manchester, from an accurate analysis of various kinds of foreign and domestic salt, which we have extracted from his interesting paper on the subject, published in the *Philosophical Transactions* for 1810. From these results it will be seen, that foreign salt, in favour of which a prejudice has so long existed, in place of being superior to the Cheshire salt, is really inferior to it in those points on which its primary quality depends.

One Hundred Parts by Weight consist of

Different kinds of Salt analysed.		Insoluble Matter.	Muriate of Lime.	Muriate of Magnesia.	Total earthy Muriates.	Sulphate of Lime.	Sulphate of Magnesia.	Total Sulphates.	Total Impurities.	Pure Muriate of Soda.
Foreign salt from bay water,	St. Ubes......	9	A trace	3	3	23½	4½	28	40	960
	St. Martin's..............	12	...	3½	3½	19	6	25	40½	959½
	Oleron....................	10	...	2	2	19½	4¼	23¾	35¾	964¼
British salt from sea water,	Scotch (common)........	4	...	28 &c.+	28 &c.+	15	17½	32½	64½	935½
	Scotch (Sundays).........	1	...	11½	11½	12	4½	16½	29	971
	Lymington (common)..	2	...	11 &c.+	11 &c.+	15	35	50	63	937
	Lymington (cat).........	1	...	5	5	5	5	6	12	988
Cheshire salt,	Crushed rock.............	10	$0\frac{1}{16}$	$0\frac{3}{16}$	3¼	6½	0¼	6½	16¾	983¼
	Fishery....................	1	0¼	0¾	1	11¼	...	11¼	13¼	986¾
	Common..................	1	0¼	0¾	1	14½	...	14½	16½	983½
	Stoved.....................	1	0¼	0¾	1	15½	...	15½	17½	982½

Besides the works quoted under the different articles referred to in this work, the following books may be consulted.

Ludolf, *Historia Ethiopica*. Brownrigg's *Art of making Common Salt*, 1748. Watson's *Chemical Essays*, vol. ii. Fossombroni on Salt Works, in the *Mem. Sociel. Italian.* vol. vii. p. 57. Lee on enclosing a Salt Marsh, *Transactions of the Society of Arts*, vol. viii. p. 114. *Philosophical Transactions*, No. 61. and 413. Wraxall's *Memoirs of the Courts of Berlin, Dresden, Warsaw, &c.* Leigh's *History of Lancashire*. Masson, *Phil. Trans.* vol. lxvi. p. 297. Dr. Henry, *Phil. Trans.* 1810. Dr. Rensselaer's *Essay on Salt*, New York, 1823; and Dr. Brewster's *Edinburgh Journal of Science*, vol. i. p. 384; and vol. iv.

SALTNESS OF THE SEA IN DIFFERENT LATITUDES. See PHYSICAL GEOGRAPHY, Vol. XVI. p. 519.

SALTS, FRIGORIFIC. See COLD, Vol. VI. p. 734.

SALTASH, a borough and market town of England, in the county of Cornwall, is situated on the declivity of a steep hill, near the western bank of the Tamar, from which the principal street ascends with a steep ascent. Besides this there are other two streets, which are narrow and indifferently built. The houses, which are built of stone quarried out of the foundations, are one above another on the face of the hill, on the summit of which the mayoralty hall and the chapel are built. The mayoralty hall, erected above fifty years ago, is supported by pillars, the open space below being appropriated for the accommodation of the market people. There are here meeting-houses for Baptists and Wesleyan Methodists; and a small free school, said to have been founded by Queen Elizabeth. The ferry over the Tamar, the privilege of dredging for oysters, and certain duties payable by masters of ships, produce an annual revenue of about £300 to the corporation.

The village of St. Stephen's, where the church of the parish to which Saltash belongs stands, is about a mile to the south-west. The church is a spacious structure, with a lofty tower at its west end. In the vicinity are the remains of that almost unfrequented fortress, Trematon castle. The inhabitants of Saltash are chiefly fishermen. The town sends two members to parliament. Population about 1150.

SALTCOATS, a seaport town of Scotland, in the parishes of Ardrossan and Stevenston, and county of Ayr, situated on the eastern coast of the Firth of Clyde. About 140 years ago it consisted only of a few houses; but it now contains several streets, with excellent, handsome, and even elegant houses. There is here a Relief meeting-house, and also places of worship for Burghers and Antiburghers. As the salt water is here remarkably pure, from there being no rivulet within five miles of the place, Saltcoats is much resorted to for sea-bathing. The harbour, which is safe and commodious, has good quays and piers, admits vessels of 100 tons fully loaded, and can contain twenty or thirty of them. In the year 1819, 612 tons of salt were made at the salt pans here. In the same year, the shipping belonging to the port amounted to 35 vessels, navigated by 234 sailors, and containing 3324 tons. There was also exported 14,346 tons of coal, and imported 204 quarters of grain. Ship-building was formerly carried on here to a considerable extent; but at present little business is done in it. There is here a chemical work for making magnesia and epsom salts. Population about 3413.

SALVADOR, ST. or BAHIA, a large and wealthy city of Brazil, situated at the entrance of All Saint's Bay. The city consists of two parts, one built on low ground near the shore, and consisting of streets filled with storehouses, &c. the other on a high hill, which is inhabited by all the principal people. The streets are very narrow, ill-paved, and dirty, especially the backs of them, which are the receptacles for the most intolerable filth. The principal squares are, the Royal Square, contiguous to the palace, and the square of the Jesuits. The governor's palace, an old and paltry building, occupies one side of the Royal Square; and the mint and public offices the opposite side. The court-house stands on the third side, and the senate hall and the prison occupy the fourth side. The buildings of the city are ill constructed, and rapidly decaying. The houses have all latticed windows and balconies. The principal public buildings are the churches. The cathedral, which is on a great scale, is falling into decay. The college, and archiepiscopal palace adjoining to it, which are finely situated on the summit of the hill, are kept in good repair. The handsomest structure in St. Salvador is the great church of the ex-Jesuits. It is built wholly of marble, brought over from Europe at a great expence; and its interior decorations correspond with its external magnificence. The rails of the altar are of brass, and the wood work is inlaid with tortoise shell; and the chancel, side aisles, altars, and recesses, are covered with a profusion of gildings, paintings, and images. The college and monastery contiguous to the church, have been recently fitted up as an hospital. The books and MSS. belonging to the college are heaped together in a very neglected state.

The Franciscan church and monastery are very large edifices. The monastery is two stories high, and the rooms of the monks open into corridors, which front a spacious quadrangular court, with a fountain in the centre, the walls of the court being ornamented with European blue tiles in compartments containing historical compositions.

Adjoining these buildings is another for the brothers of the Franciscans, who may prefer a secluded life in their old age. It has a curious stucco front, and a handsome cemetery, having two rows of arched vaults three tiers deep, each vault being the receptacle of a single coffin. The vaults are white-washed, and between the two rows is a broad space paved with marble, with a drapery figure of religion at the end of it. This cemetery is kept very clean, and is ventilated by windows in the roof.

The church of the Carmelites is a more handsome, as well as a more modern building than that of the Franciscans, and the adjacent monastery is unusually rich. The buildings of the Benedictines are inferior to those described. There are many other churches, chapels, monasteries and convents, which, though worth visiting, are scarcely worth describing. The principal parish churches are those of the Concession, Pillar, and St. Peter within the city, and those of St. Antonio and Victoria without the city.

The prison, which stands in one of the sides of the royal square, is a spacious building. In the dungeons in its lowest division, there is a passage by trap doors from a grated room above. In the first story there is a central apartment surrounded with a number of dark cells, about six feet square, which have no windows, but are furnished with a heavy chain fastened to a ring. There are commonly 200 persons in the prison. Adjoining to it is a small hospital. On the beach, there are a custom-house, a dock-yard, magazines for stores and wharfs.

The city is protected by several forts, the principal of which is that of Do Mar, built on a rock in the inner bay about half a mile from the shore. It mounts about 40 guns, and holds a garrison of 500 men.

On the extreme point of the peninsula is the ancient fort and lighthouse of St. Antonio, Do Barro, and the bay near the bar is defended on the one side by the small fort of Sta Maria, and on the other by the circular battery of St. Diego. At the end of the city towards the sea is an eighteen gun battery in pretty good condition. The dock-yard is defended by the bulwark battery of St. Philips, mounting about thirty cannon. Besides some other small batteries, the city is protected by three forts on the land side, and the fortification of St. Pedro. There are about 5000 infantry in the city.

Beside the governor's dock-yard, there are several private ones, where many merchant vessels are built.

The principal trade of St. Salvador, which is very considerable, consists in linen, cloths, silk and thread stockings, hats, grain and flour, wines, bottles, and bacon, all of which it imports; exporting in return, gold, tobacco, sugar, Brazil wood, skins, balsam of capivi, ipecacuanha. Population about 100,000, of whom about 30,000 are whites, 30,000 mulattoes, and 40,000 negroes. West long. 38° 32′ 30.″ lat. 12° 58′ S.

SALVAGES, a group of uninhabited islands or rocks, lying to the north of the Canary Islands, and belonging to Portugal. The largest is about three miles in circumference, and a few leagues to the north-west of them is another like the largest needle rock; at the west extremity of the Isle of Wight. A great number of cormorants and sea-fowl are caught on the island by the inhabitants of the Canary Islands. The largest island has produced in one year forty ton of the dye called orchilla.

According to Lieut. Mudge, who surveyed the great Salvage island in 1820, along with Lieut. Vidal, it is of volcanic origin, and consists principally of dark coloured black rock, which has a fixed magnetic polarity. Even the dust of the roads and of the floors of the cottages may be gathered up like steel filings by a bar magnet. A plan of the island communicated to Dr. Brewster by Lieutenant Mudge, is published in the *Edinburgh Philosophical Journal*, vol. v. p. 381. Position of Lieut. Mudge's station 15° 56′ 18″ west long. and 30° 27′ 39″ north lat.

SALUZZO, a town of Piedmont, and the capital of a district of the same name, is situated near the source of the Po, at the foot of the maritime Alps. It stands on a hill in the midst of a plain, and thus enjoys both salubrious air, and an extensive prospect. The town is tolerably well built, and besides the cathedral, contains two churches and several religious houses. The ancient palace was once the residence of the Marquis of Saluzzo. Corn, hemp, fruit, wine, and particularly silk, are the productions of the place. Population about 10,000.

The district of Saluzzo belonging to the king of Sardinia, has an area of about 750 square miles, and a population of about 125,000. It is bounded by Dauphiny on one side, and the country of Nice, and the valley of Lucerne on its other sides.

SALZBURG, a city of Austria, and capital of the principality of the same name, is situated on the banks of the Salza, between three mountains, at the mouth of a long valley, which crosses the Rhœtian Alps. The river divides the city into two parts, which communicate by a bridge. The town is in general well built, but the streets are narrow and ill built. It has long been the seat of an archbishop, and contains a great number of churches and ecclesiastical buildings. The archiepiscopal palace is a large and magnificent edifice. In front of it is a beautiful fountain, and opposite to it is a fine palace called the Henebau, in which the courts are held; and also the meetings of the different colleges. It contains also the library of the archbishop. The palace of the bishop of Chiemsee, the chapter-house and the apartments for the canons are elegant buildings. The cathedral of St. Rupert, built in the Roman style, is more solid than elegant. It was consecrated in 1628, and is built of freestone and marble, and has two towers in front. It has five organs, and a grand treasury. The university church, consecrated in 1707, is a good building. The church of St. Peter is the oldest in the city, and near it is a monastery of benedictine monks, which possesses a fine library. The other churches of Salzburg are those of the Franciscans, the Theatins, the Holy Trinity, and St. Sebastian. The cemetery is reckoned one of the finest in Europe, and contains the tomb of

Salzburg.

the celebrated Paracelsus. Among the other objects of interest here are the stables on the side of the Moensberg, and the three galleries excavated out of the solid rock of 220 feet long; the hospital of St. John, the portrait of Paracelsus, painted in the house in which he died, at the corner of the street Linz. The new gateway, excavated out of the rock in the Moensberg, has a length of 300 feet, a height of 30, and breadth of 24 feet, was executed under the direction of the bishop, whose bust is erected here, with the appropriate incription of *Te Saxa loquuntur*.

The university of Salzburg, founded in 1620, by Archbishop Paris, was converted in 1810 into a lyceum or academy of theology and surgery. Among the other literary establishments are an institution for educating country schoolmasters, and two public libraries. Belonging to individuals, there are various cabinets of minerals, of natural history, of medals, and of paintings. Many of the most valuable books and MSS. were carried off by the French in the revolutionary war.

Salzburg is well fortified. The part of the city to the right of the river is encircled with eight bastions, and the part on the left side with three. The Mountain Castle, containing the principal arsenal, situated beside the eighth bastion, is very strong on account of its lofty situation.

Salzburg enjoys the most romantic situation among finely shaped and elevated mountains, and the view of the town itself, and those which may be commanded from the adjacent heights, particularly the top of the Moenschberg, are among the finest in the world.

Among the principal objects of interest in the vicinity of Salzburg, are the chateau of Helbrunn and its amphitheatre of rocks, Gastein and its golden mines; which yield annually 100 marcs of pure gold, besides a considerable quantity of silver, copper and lead; and also its baths and fine romantic situation; Berchtolsgaden, already described, (see Vol. III. p. 462,) and the lake of Barthelemé, and the salt pits of Hallein, which will be noticed in the following article.

Salzburg has few manufactures except hardware articles. In 1818, above 100 houses were destroyed by accidental fire. Population 15,000. East long. 13° 1′ 35″ north lat. 47° 48′ 10.″ For farther information respecting this interesting place, see *Beschreibung des Hauptund Residenzstadt*, von L. Hubner. Salz. 1792, 2 vols. *Reise durch das Erzstift Salzburg, zum Unterricht und vergnugen.* V. Hubner. *nebst Stundenzeiger und Strassenkarte*, 1796, 8vo. Schultes, *Reise durch Salzburg und Berchtesgaden.* Vienne, 1804, 2 vols. 8vo.

SALZBURG, is a province of Austria, bounded on the east by Styria, on the south by Carinthia and the Tyrol, and on the north and west by the kingdom of Bavaria. It extends about 100 miles from east to west, and about 64 from north to south; but it does not now contain more than about 28,000 square miles. This province consists principally of the great valley watered by the Salza, and partly of a succession of smaller valleys, with their intervening mountainous ranges, in the southern part of the province which includes a portion of the Noric Alps. The country has all the accompaniments of Alpine scenery, mountains, lakes, glaciers, avalanches, and has a more severe climate than might be expected in such a latitude. In the immediate vicinity of Salzburg, even the hills are covered with snow before October, though it does not lie permanently till November. The winter continues in the south from November to April, and frosts and showers continue till about the end of June. Vegetation then makes a rapid stride, the heat sets in with great intensity, and the sirocco sometimes passes along the vallies for a day, and produces the languor which characterises it. It always occasions a sudden thaw and flood.

The low and fertile grounds of the vallies of the Salza produce oats, barley, and even wheat, which afford subsistence to breeds of valuable cattle; but its supplies of corn are derived from Bavaria. The province also possesses extensive pasturages; and the horses are prized for their beauty and hardiness and vigour; but its principal wealth is derived from its mines of rock salt in the northern districts, and from the gold, silver, iron, copper and lapis calaminaris, which is found in the southern district.

The salt works of Halleins are said to be worth about L.100,000 annually. The descent to the mines is by sliding along wooden beams, and persons leave them by a gallery or horizontal path seated on a bench with wheels drawn by the miners. There are at Hallein thirty-two reservoirs, each of which contains about 700,000 *seaux*. The rock salt of various colours is converted into the finest salt, which is exchanged in Bavaria for corn. The illumination of the salt mines has a superb and magical effect.

Most of the metals obtained in this province are exported in their raw state, the materials being only smelted and the iron being exported in bars. A considerable quantity of steel and brass, however, is made into swords, sabres, bayonets, musquets, cannon, and mortars.

Although the only form of religion tolerated is the Roman Catholic, yet there are a considerable number of Lutherans, nearly 3[illegible],000 of the inhabitants of this persuasion being compelled in 1733 to avoid the persecutions to which they were exposed. In 1806 Salsburg was added to Austria. In 1807 it was transferred to Bavaria, and in 1817 it was restored to the Austrian government, who draw from it an annual revenue of about L.100,000. Population about 142,000.

SAMAR, one of the Philippine Islands, lies on the south-east side of Luzon. It is about 140 miles long, and 60 broad. See our article PHILIPPINE ISLANDS, Vol. XVI. p. 449.

SAMARANG. See JAVA, Vol. XI. p. 626.

SAMARCAND, a celebrated city of Asia in Great Bucharia. It is situated in a delightful region on a small river called Sogd. At one time it was one of the finest cities of the east, and is said to have had a population of 150,000 in A.D. 1400. Although it has now declined from its former greatness, it is still a large and well peopled city, with many grand stone edifices, and strongly fortified with earthen bulwarks. It supplies Hindostan and great part of Persia with melons, grapes, apples, pears; and the silk paper which is manufactured here is highly valued, and considered the finest in Asia. East Long. 64° 9′. North Lat. 39°, 37′, 23″.

SAMOIDES. See POLAR REGIONS in this volume, p. 28.

SAMOS, an island in the Grecian archipelago, on the coast of Asia Minor, from which it is separated by a channel scarcely half a league wide, called Little Bogas. It is about twenty-four miles long, twelve broad, and about seventy in circuit. In its length it is interrupted by Cape Colonni, a narrow cape which projects far to the south, and is separated by the sea into portions called Samo-poulo or Little Samos. On the west side of Samos lie the Fourpie Islands, anciently the Corseæ Insulæ, which are divided from Samos by a

Sanda
||
Sandwich
Islands.

strait about two leagues wide, called the Great Bogas, in which there is good anchorage, and which is much frequented by ships from Constantinople to Syria and Egypt. Samos contains two ranges of lofty mountains, some parts of which are rocky and bleak, while others are covered with trees and display much picturesque and beautiful scenery. The plains which lie between these ranges are rich and well cultivated, and produce in abundance, grain, vines, melons, lentils, French beans, &c. The bread is made of equal parts of wheat, barley, and white millet. A great deal of pitch is made from the pine trees. The honey and wax of Samos are in great request. Cattle are bred in Samos; but the goats are more numerous than the sheep. There are in Samos, horses, wild boars, and some deer; partridges, woodcocks, snipes, thrushes, wood pigeons, turtle doves, wheat-ears, &c.

Among the natural productions of the island are, lead, silver, and some say gold, iron, corundum or emery stone, white marble, and abundance of ochre. The muscadine wines of Samos are said to possess the qualities of those of Cyprus, when properly managed.

The principal town of the island is Vahti on the north side of it, which has a large and commodious harbour. About two leagues from Cora, which bears the title of the capital, are the remains of the ancient city of Samos. The walls of the ancient city still remain, composed externally of white marble, the middle space being filled up with small stones. Their thickness varies from ten to fifteen feet, and they are covered at top with large hewn stones. The square towers upon them are not above fifteen feet high. Here are the remains of a theatre, 240 feet wide, and having the space for the seats eighty feet broad. The seats were not built on arches but on the sides of the hill. Several of the faces and pedestals of the celebrated temple of Juno still remain half buried in the ground, and there is an entire shaft still remaining. The capitals appear to have been Doric. Dr. Pocock saw part of a large statue of grey marble which seemed to be very fine, but it had neither legs nor arms. On the west side of the town are to be seen the ruins of several very considerable buildings.

Samos is reckoned the noblest island in the archipelago. It exports about 22,000 castors of grapes, about 15,000 barrels of raisins, and wine in such quantities that the duty amounts to 36,000 piastres. The other duties amount to about 12,000.

Although the island is under the power of a governor appointed by the Porte, who pays 180 purses for his office, yet the island is under the jurisdiction of three chiefs chosen annually, elected by three persons from each village called primates. There are about eighteen large and twenty small villages, and the population of the island, according to Mr. Turner, is about 60,000. East Long. 16° 50′. North Lat. 37° 48′.

SAMSOON, the ancient Amisus, is a sea-port town of Asiatic Turkey. It is situated near the west end of a bay of the Black Sea, about four miles long, and embosomed in groves of olive trees. The houses, which are of wood plastered with mud, are white-washed. It is surrounded with a ruinous wall, and contains five mosques with minarets, and a large khan for the use of the merchants who trade with Constantinople and the Black Sea. The surrounding villages are inhabited by Christians. The inhabitants of the town, who are principally Turks, amount to 2000.

SANA, a city of Arabia in the province of Yemen, situated in a stony valley, and surrounded with elevated hills. It is considered one of the handsomest cities in Asia. It is said to be larger than Bristol, but less populous, from the number of gardens within its walls. There are many handsome houses built of stone and of brick, and numerous mosques, palaces, and public baths. The city is surrounded with a strong wall of mud. Many different species of grapes are said to be cultivated here, and there is a great exportation of raisins. An interesting account of Niebuhr's visit to Sana, and of the state of the city at that time, will be found in his travels. East Long. 44° 9′. North Lat. 15° 20′.

SANDA, a small island of Scotland in the county of Argyle, and on the coast of Kintyre. It is about a mile and a half long, and half a mile broad. Along with the islets on the east of it, it forms a good pasturage for sheep. Paterson's Rock, a dangerous sunken rock about a mile in circuit, lies to the south-east of Sanda. The ruins of an old Popish chapel, dedicated to St. Columba still exist on the island.

SANDEY. See ORKNEY ISLANDS, Vol. XVI. p. 8. col. 2.

SANDWICH, a borough town of England in Kent, is situated on the river Stour, about two miles south from Sandwich haven. The town, which has a very ancient aspect, is irregularly built, and consists of streets and lanes that are both narrow and inconvenient. A considerable part of its walls still remain, but all the gates have been taken down excepting Fishergate, which opens to the river. The principal public edifices are, the three parish churches, the guild or court hall, and the free grammar school. St. Clement's church, which is a very spacious building, has a massive tower rising from four semicircular arches in the centre of the building. It contains numerous sepulchral inscriptions. St. Peter's church possesses several ancient tombs supporting effigies. St. Mary's church is a large building, consisting of a nave, chancel, and north aisles, and contains many sepulchral monuments.

The guild hall, built in 1579, has the court hall in its lower story, and the council chamber in its upper one. Besides the free grammar school, there is here a charity school for thirty boys and thirty girls. There are also three hospitals for aged poor. Sandwich is governed by a mayor, twelve jurats, twenty-four common councilmen, a steward, recorder, townclerk, &c. It sends two members to Parliament, who are chosen by 850 voters.

Shipbuilding and ropemaking are carried on here to a considerable extent. The principal exports consist of grain, flax, corn, seeds, hops, wool, malt, apples, pears; leather, oakbark, ashes, &c. The imports are groceries, furniture, linen, woollen, and other shop-goods from London, iron, plank, spars, timber, lead; coals, salt, wines, spirits, glass, grindstones, &c. from Wales, Scotland, Norway, Sweden, and the Baltic. Population about 3000. See the *Beauties of England and Wales*, Vol. vii.

SANDWICH ISLANDS, a groups of islands in the Pacific Ocean, discovered by Captain Cook and Captain King in 1778, and so named in honour of the Earl of Sandwich. They were again visited by Captain King in 1779, and afterwards by Vancouver, Meares, Turnbull, and other navigators. The following is a list of them, with their position and population:

		East Long.		North Lat.		Population.
Owhyhee.	North Point	204°	2′	20°	17′	150,000
	South Point	204	15	18	54	
	East Point	205	6	19	34	
	Karakakoa Bay	214	0	19	28	

		East Long.		North Lat.		Population.
Mowhee.	East Point	204°	4	20	10	65,000
	South Point	203	48	20	34	
	West Point	203	24	20	54	
Morokinnee		203	33	20	39	Uninhabited.
Tahoorowa		203	27	20	38	
Ranai South Point		203	8	20	46	20,000
Morotoi West Point		202	46	21	18	36,000
Woahoo Anchoring Place		202	9	21	43	60,000
Atooi Wymoa Bay		200	20	21	57	54,000
Oneeheow Anchoring Place		199	45	21	50	10,000
Oreehoua		199	52	22	2	4,000
Tahoora		199	36	21	43	Uninhabited.

The manners and customs of the Sandwich islanders have already been sufficiently described in our account of the principal island OWHYHEE, Vol. XVI. p. *183.

SANGIR, an island in the eastern seas, about sixty-three miles in average length, and twelve in breadth. Taroona, the principal town, stands about the middle of the west coast, in north latitude 3° 28′ and east longitude 125° 44′. The island abounds in cocoa nuts, from which an oil is expressed. Spices also are exported to Magindanao. Sangir is encircled with forty-six smaller islands. About the middle of a ridge of high mountains in the south end of the island, is a lofty mountain from which there was a volcanic eruption in 1711. Population about 12,000.

SANQUHAR, a royal burgh of Scotland in Dumfries-shire, is situated on the river Nith. It consists chiefly of a single street about a mile in length. At the head of the town stands the council-house with a school-house and prison connected with it. This elegant building, designed by Mr. Adam, has a handsome spire, and was presented to the burgh in 1734, by the Duke of Queensberry. About half a mile south-east of this stands the old castle of Sanquhar, once a building of considerable size and extent. Beside the parish church, the east end of which is of very ancient architecture, there are places of worship for the United Secession Church, and for the Baptists. Different branches of the carpet manufacture are carried on here, and the knitting of stockings is pursued to a small extent. This burgh unites with Dumfries, Annan, Kirkcudbright, and Lochmaben in sending a member to Parliament. It is governed by a provost, three bailies, a dean of guild, a treasurer, and eleven councillors. Population about 2000.

SANTA CRUZ. See TENERIFFE.

SANTA CRUZ DE LA SIERRA. See BUENOS AYRES, Vol. IV. p. 48.

SANTA CRUZ, OR AGADIER. See MOROCCO, Vol. XIV. p. 723.

SANTA FE DE BOGOTA. A town of South America, and the principal town of New Granada, a division of Spanish America. It is situated at the foot of a steep mountain at the entrance of a fine and extensive plain. Population about 40,000. West Long. 60° 5′ and North Lat. 3° 58′. See GRANADA NEW, Vol. X. p. 446.

SANTIAGO. See CHILI, Vol. VI. p. 192 and 193.

SANTIAGO. See IAGO ST.

SANTORINI or ST. IRENE, anciently THERA and CALISTA, is a rich and populous island in the Grecian archipelago. It is about eight miles long, and has the form of a crescent, containing within it the islands of Thesaria and Aspronisi. The principal villages in the island are Pyrgos, Apanomeria, Scauro, Emborio, and Acroteri, besides many others of less note. The principal productions of the island are barley, cotton, wax, figs, and almonds. The principal revenue of the island is derived from wine, the best kind of which is called the vino santo, which is preferred to the best Cyprus wine. The quantity of wine annually exported is reckoned at a million of okes.

Santorini and the adjacent islets are of volcanic origin. After emerging from the bottom of the sea, it was swallowed up in the year 237 B. C. The poorest villages are merely a collection of caverns cut out of the pumice stone with which the island is almost wholly covered. The inhabitants elect their own magistrates, but they pay a tribute of L.11,000 annually to the Porte. Sonnini makes the population of the island 9000, and Olivier 12,000. East Long. 25° 36′. North Lat. 36° 28′. See Sonnini's *Travels*, and Olivier's *Travels*, &c.

SANTOS, a seaport town of Brazil in the captaincy of St. Paul's. It has rather an unhealthy situation on a river or lagoon formed of various mountain streams which intersect the land in every direction, and unite a little above the town. The depth of the river is about three or four fathoms. The harbour, which is the strait between the island of St. Vincent and the mainland, has a good anchorage. The place called the narrows is defended by two forts. The river is navigable about twenty miles up to Caberton. A great intercourse is carried on between St. Paul's and the port, several hundred mules often arriving in the day loaded with the produce of the country, and returning with iron, copper, salt, earthenware, and European manufactures. Sugar, coffee, rum, rice, indigo, mandioca, are exported to Rio Grande and the Spanish territory, from which in return they receive hides and tallow which are exported to Europe. The population, consisting chiefly of merchants, shopkeepers, and artificers, amounts to about 7000. West Long. 46° 21′. South Lat. 23° 59¼′ S.

SAONA, a West Indian island, situated near the south-east end of St. Domingo, at the distance of only half a league from Pt. Palmilla. It is about twenty miles long, and six broad. It abounds in pigeons, and in various terrestrial and aquatic birds, and contains also many wild cattle. It was discovered by Columbus in 1494. The Jesuits had formerly several settlements and pasture lands upon it, but it is now uninhabited. West Long. 69° 42′. North Lat. 18° 8′.

SAONE UPPER, one of the eastern departments of France, is bounded on the north by the department of the Vosges, on the east by that of the Upper Rhine, on the south by those of the Doubs and Jura, and on the west by those of the Cote d'Or and Upper Marne. It contains about 2500 square miles, and is about twenty-six French leagues long, and seventeen broad. The surface is hilly, and some branches of the Vosges mountains pass across it. It is watered by the Saone, the Oignon, the Drugeon, and the Amance. The soil, though stony, is fertile, and its chief productions are corn, hemp, wine, fruit, wood, salt, iron, and coal, the two last of which are the most important. Vesoul is the capital of the department. The contributions in 1805 were 2,199,713 francs, and the expence of the state, 215,983. Population 312,000.

SAONE and LOIRE, one of the eastern departments of France, is bounded on the north by the department of the Cote d'Or, on the east by that of the Jura, on the south by those of the Ain and the Rhone and Loire, and on the west by those of the Allier and the Nievre. It contains about 3500 square miles, and is about thirty-four French leagues long, and twenty-four broad. It is covered with mountains, hills, and forests, separated by wide plains and vallies. It is watered by the Saone, the Loire, the Arroux, the Doubs, and the Seille. It enjoys also a water communication between the Mediterranean and the Atlantic by means of a canal which joins the Saone and Loire. The soil, though stony and sandy in some places, is rich and fertile in others. It produces corn, hemp, wines, and fruits; and iron, coal, marble, alabaster, and other minerals occur in the hilly districts. Maçon, the wine of which is celebrated, is the capital of the department. The contributions, in 1803, were 4,376,459 francs, and the expences of the state, 308,219 francs. Population 447,565.

SAP. See Botany, Vol. IV. p. 52.

SAPPARE. See Kyanite in Mineralogy, Index.

SAPPHIRE. See Mineralogy, Index.

SAPPHO, a celebrated Greek poetess, was born at Mitylene in Lesbos, about the year 610 B. C. After she had lost her husband, she seems to have addicted herself to poetry and to licentiousness. She has been as much condemned for her sensualities as she has been famed for her lyrical effusions. She is said to have thrown herself over the famous precipice of Leucate, in consequence of the refusal which she experienced from the beautiful Phaon, of whom she was greatly enamoured. An ode to a young female, and a hymn to Venus, are the only productions of Sappho which have descended to our times. She is said to have formed an academy of females, who excelled in music, and to have invented the mixolydian mode.

SARACENS. See Arabia, Vol. II.

SARAGOSSA, or Zaragosa, anciently *Salduba* and *Cæsar Augusta*, an ancient and large city of Spain, and the capital of Arragon. It is situated in a fertile plain, on the south bank of the Ebro, at the confluence of the rivers Galego and Huerva, the former of which flows through Arragon from the south, and the latter from the north, having its source in the Pyrenees. The Ebro, which is here navigable, flows between the city and its suburbs, and is crossed by two bridges, one of stone of seven arches, and the other of wood, which is reckoned one of the finest in Europe. The city is encircled with an earthen wall, and has twelve gates, some of which are old ones in the wall of Augustus. With the exception of one wide street called Calle Santa, the streets are narrow, crooked, and irregular. The houses, which are of brick, are generally old, though built with tolerable regularity.

Saragossa contains seventeen churches, and nearly forty convents. The principal public buildings are the cathedral, a large and wide Gothic building; the church of Nuestra Dona del Pelar, which is a superb building, with a fine Gothic altar of alabaster, and which was celebrated before the siege of 1808 for its valuable relics; the leaning tower, resembling that of Pisa; the Lonja, or exchange; the hotel of the deputation; and the house of Pity. There is also here one university, founded in 1474, which contained 2000 students; and there are two public libraries. Saragossa has neither commerce nor manufactures, and hence the city is remarkable for its dullness. The new canal of Arragon,* which passes through the lands in its vicinity, though it has been of immense advantage to the agriculture of the country, has not yet contributed to excite a spirit of industry and enterprise among the inhabitants. Population about 42,600. West Long. 0° 48', North Lat. 41° 44'. A full account of the celebrated siege which this city sustained in 1808, will be found in our article Britain, Vol. IV. p. 694, 704. See Laborde's *View of Spain* for a full account of this city previous to the late revolution in Spain.

Sardinia.

SARDINIA, the name of a kingdom in the south of Europe, including the island of Sardinia in the Mediterranean, from which it derives its name, Piedmont, Savoy, the territory of Genoa, a part of the Milanese territory, and the duchy of Montserrat.

The following Table shows the extent and population of these different states:

	Extent in square Miles.	Population.	Chief Towns.	Population.
Island of Sardinia	9,250	520,000	Cagliari	35,000
			Sassari	25,000
Piedmont and Nice	7,900	1,750,000	Nice	19,000
			Turin	65,000
Savoy	3780	450,000	Chamberry	12,000
Genoese territory	2360	534,000	Genoa	76,000
Part of Milanese territory	3310	560,000		
Duchy of Montserrat	900	186,000		
	27,500	4,000,000		

For a particular account of these territories, see Genoa, Nice, Milan, Sardinia, and Savoy.

The Sardinian states were erected into a kingdom in 1720, when Amadeus II. assumed the royal title. Having taken a part in the French revolutionary war, the king of Sardinia was compelled, in consequence of the annexation of his continental states to France, to remove to Sardinia. The liberation of Europe in 1814, restored the Sardinian monarchy; and, in 1815, the congress of sovereigns at Vienna added to it the territory of Genoa.

The revenue of this kingdom is estimated at about million and a half sterling. The standing army is nearly 60,000, and the national militia about 40,000.

The religion of the king and of all his states is Catholic; but the consent of the king is necessary to the promulgation of any papal bull or mandate. Courts of justice are held at Turin, Genoa, Chamberry, Nice, Cagliari, and Sassari. See Cagliari, Chamberry, Nice, and Turin.

SARDINIA, a large island in the Mediterranean Sea, belonging to the king of Sardinia, and situated to the south of Corsica. It is of an oblong form, about 162 miles long from north to south, and about 65 miles broad. It contains about 9250 square miles, reckoning the small islands upon its coast. The island is divided nearly into two equal parts, viz. Capo di Sassari, which is the northern half of the island, and Capo di Cagliari, or the southern half. The highest hills are in the north part of the island, and extend from north to south. The loftiest are Limbara, Villa-Nova, Arizzo, and Fonni, which are commonly capped with snow. The principal rivers are the Oristano, which runs about eighty miles from east to west; and the Flumendoso, which flows in the opposite direction, and divides the island into two portions. There are several small fresh water lakes on the coast, and a number of bays of the sea almost encircled by the land. The principal bays in the south are those of Cagliari, where whole fleets may lie at anchor in the worst weather, and of Santa Rosa; those on the west coast are

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* See Navigation *Inland*, Vol. XV. p. 228.

Sardinia, Sari.

Alghero and Oristano; while Sassari is the only one on the north. Excepting some sandy tracts along the coast, the soil is generally fertile, producing wheat, barley, beans, lentils, and wines. Wheat yields a return of from fifteen to twenty times the seed, and several crops a much greater increase. The wines of Sardinia are good, that of Nasco being the most esteemed. There are here groves of wild olive trees, which also form an object of cultivation. The lofty palm tree adorns the forests, and the orange, lemon, mulberry, pomegranate, jujube fig, and other fruit trees, are common. The interior of the island is a wild desert, covered with large forests of oak, cork, and chesnut trees.

The wild animals of Sardinia are horses, deer, sheep, boars, wolves, foxes and hares. The wild horses are found chiefly in the districts of Bultei and Nurra; but they are still more numerous in the isle of St. Antico, in the forest of Canais. These horses are very small, but extremely active and well made. The wild sheep are found in the mountainous regions, and sometimes cohabit with the tame ones. The rams have from four to six horns, and are numerous and ferocious. The wastes and morasses abound with wild ducks.

Among the mineral productions of Sardinia are silver and lead. The principal silver mines are those of Gaspini, Arbus, and Argentera; and the lead occurs in hills of argillaceous achistus and limestone. The lead mines of Iglesias yield from sixty to eighty pounds in the cwt. The value of the mines is estimated at 321,000 francs. Porphyry abounds in the mountains of Nurra, and granite is found principally in Gallura. Chalcedonies, agates, cornelians, turquoises, are found in the northern mountains.

The climate of Sardinia has an insular character, possessing a lower mean temperature than that of similar parallels on the continent. In the summer months the heat is very intense, and produces local insalubrity in the marshy districts, arising partly from the northern winds being obstructed by the mountains in the north of the island.

Although Sardinia possesses many good harbours, such as those of Palmas, Nova, and Cagliari, yet from a want of capital as well as enterprise, and from the extreme ignorance of the people, the island is blessed neither with trade nor manufactures. A few coarse linen and woollen goods are made in the island. The produce of the herring and coral fisheries, corn, cattle, and salted provisions, hides, skins, fruits, a little wine and brandy, and large quantities of salt, are the principal exports, the annual value of which has been estimated by Azani at 8,000,000 livres. The imports have been calculated at 2,000,000 livres, and the annual revenue at 1,695,052 francs.

The religion of the island is Roman Catholic, and there are three archbishops and six bishops. The judges are paid by an allowance for each sentence. There is a university at Cagliari, and another at Sassari. The upper classes speak good Italian. A dialect of the Spanish is spoken in some places. The Sardinian language is a mixture of Italian, Spanish, Greek, and French. The population of Sardinia in 1790 was about 456,990. By a more recent return it is nearly 520,000. See Arthur Young's *Journey in France*, vol. ii. and Cagliari and Sassari.

SARI, a town of Persia, in the province of Mazanderan. It is a small but well fortified place, encircled with a good wall and a deep ditch. In the time of Hanway it had four or five temples of the ancient Persians, built of solid materials, and about 120 feet high. The town carries on a brisk trade with Astracan and the interior of Persia. East Long. 52° 58′, North Lat. 35° 35′.

SARIGAN. See Ladrones, Vol. XII. p. 499.

SARK, Serk, or Cerq, an island belonging to England, but situated on the French coast, within six miles of Guernsey. It is about three miles long, and at an average one mile broad. It is divided into the great and little Sark, which are united by a bridge 250 feet high, along which there is a narrow foot path. About 500 acres of the island are cultivated, and produce most kinds of grain, apples, of which cyder is made, turnips, carrots, &c. The principal manufacture of the island is the knitting of stockings, gloves, and Guernsey jackets. Several small vessels are employed in carrying on a trade to Bristol and some of the western ports. In 1812 the population was 416, the number of houses 68; the draught oxen 48, the young cattle 100, the cows 120, and the sheep about 350. West Long. 2° 52′, North Lat. 49° 30′.

SARKFOOT, a small village and sea-port town of Scotland, in Dumfries-shire, is situated on the northern shore of the Solway Firth. The harbour admits vessels of about 120 tons burden. Near this village, on the farm of Gretna Mains, is a large Druidical temple, one of the stones of which contains 118 cubical feet, and weighs twenty tons. See the *Statistical Account of Scotland*, vol. ix.

SARSAPARILLA. See Materia Medica, Vol. XIII. p. 353.

SARTHE, or Sarte, one of the departments in the north-west of France, is bounded on the north by the department of the Orne; on the east by those of the Eure, the Cher, and the Loire and Cher; on the south by the Indre and Loire, and Maine and Loire; and on the west by that of the Mayenne. Its form is almost circular, and its area is about 2490 square miles. There are several hills in the north-west of the department. The rivers are the Sarthe, the Loire, and the Huine. The productions of the soil, which is of a limy and gravelly character, are wheat, rye, barley, flax, wine, and fruits. Corn is imported; but wine and fruits are exported to a great extent. There are here some marble quarries and iron mines. The chief manufactures are hardware goods, paper, woollens, and leather. The contributions in 1803 were 3,986,579 francs, and the expences of its administration 292,814 francs. Le Mans is the capital of the department. Population 387,166.

SARTO, Andrea del, whose real name was Vannucchi, a celebrated painter, was the son of a tailor, and was born at Florence in 1488. He studied the elements of his profession under Giovanni Barile, with whom he continued three years. He then entered the school of Pietro Cosimo, where he made great proficiency by studying the works of Masaccio and Il Ghirlandajo, and the cartoons of Michael Angelo and Leonardo da Vinci. His first great work was to execute for the church of the Scalzi, or barefooted Carmelites at Florence, a series of pictures from the life of St. John the Baptist. His next work was ten pictures for the church of the Servi, representing the life of St. Felippo Benizi, which are regarded as among his best productions.

Upon his return from Rome, where he studied the works of Raphael, he painted the birth of the Virgin, the descent of the Holy Ghost, and the last supper, for the monastery of the Servi.

The reputation of our artist was now so great, that

Francis I. commissioned from him the picture of the dead Christ, with the Virgin, &c. which is now in the Louvre. Upon the invitation of that monarch he went to France, where he was received with the greatest distinction, and received 300 crowns in gold for a portrait of the dauphin. He painted many pictures for the French nobility; and for Francis I. he executed the picture of Charity now in the Louvre. While he was engaged on the portrait of the queen mother, he was urged by his wife to return to Florence. The king not only gave him leave, on condition that he would return in a few months with his family, and settle in France, but also made him liberal presents, and even intrusted him with a large sum of money, in order to purchase statues and pictures for the royal collection. Misled by the profligacy of his wife, he forgot his engagement to the French monarch, and squandered away the money with which he was intrusted. The poverty into which he thus fell, and the reproofs of his own conscience, brought upon him the greatest distress, and he at last died of the plague in the year 1530, in the 42d year of his age.

The most celebrated picture of Sarto is his Madonna del Sacco, so called from Joseph reclining on a sack of grain. It is considered as little inferior to the production of Raphael. See Painting, Vol. XVI. p. 238.

SASSARI, a town in the island of Sardinia. It is situated on an elevated plain, and is well built, and encircled with a wall. It stands on the river Torre, which forms at its embouchure the harbour called Porta Torre, about nine miles below the town. There are a great number of churches and religious houses in the town, and the environs of it are adorned with shady walks and fountains, one of which, called the Fountain of Rosella, built of marble, is said to equal the most splendid of the Roman fountains. The university was founded in 1777. There are some inferior seminaries; but education is not in general request. Population about 30,000, East Long. 8° 45′, North Lat. 40° 48′.

SATELLITES. See Astronomy, Vol. II. p. 623, 644, 672, 685, 706.

SATELLITE Machine. See Planetary Machines, Vol. XVI. p. 626, 643.

SATURN. See Astronomy, Vol. II. p. 646, 672, 711, 708.

SAUMUR, a town of France, and principal place of a district in the department of the Maine and Loire. It is agreeably situated on the right bank of the Loire, which here encloses an island, at which there are two stone bridges. One of them from the southern bank to the island is very handsome, and consists of twelve elliptical arches sixty feet in span. The principal street which follows the line of the bridge, contains the theatre and several other handsome edifices. There are several squares in the town. The castle, now a military depot, is an old building flanked with towers, and stands on an eminence commanding the town. There is in the neighbourhood a bridge called Pont Fouchard, completed in 1816, on a river parallel to the Loire, and having three arches of great span. Population 9585. West Longitude 0° 3″, North Latitude 47° 15′.

SAUNDERSON, Nicholas, a remarkable professor of mathematics, was born at Thurlston near Penniston in Yorkshire in 1682. When he was only a year old he lost his sight from the small-pox; but having evinced at an early age very great abilities, his father who possessed a very small estate, and held an office in the excise, sent him to the free school of Penniston, where he acquired a knowledge of Greek and Latin. While instructing him in arithmetic, his father discovered his turn for mathematics, and he introduced him to Richard West, Esq. who undertook to instruct him in algebra and geometry.

Savage, Richard.

After studying a short time at the dissenter's academy at Attercliff near Sheffield, he took up his residence in Christ's College, Cambridge, in 1707, with the view of being admitted a member of that house. He was liberally indulged with apartments and with the use of the library, and he soon began a series of lectures on the Universal arithmetic, the Optics, and the Principia of Sir Isaac Newton. In this way he was led to correspond with Sir Isaac Newton himself on some of the more difficult parts of his writings. Upon the ejection of Mr. Whiston from the Lucasian professorship of mathematics in 1711, Mr. Saunderson obtained from the queen a mandamus to confer upon him the degree of A. M. and on the recommendation of Sir Isaac Newton, he was nominated Mr. Whiston's successor. In 1723, he married the daughter of the Rev. Mr. Dickens, rector of Coxworth, by whom he had two children, a son and a daughter; and in 1728, when George II. visited the university, Saunderson, while attending on his majesty in the senate, was, by the royal mandate, created doctor of laws.

Though of a strong constitution, Mr. Saunderson suffered much from his sedentary habits, and he was seized with a numbness in his limbs, which terminated in a mortification in his foot, of which he died on the 19th April 1739, in the 57th year of his age.

Dr. Saunderson left behind him a "System of Algebra," in 2 vols. 4to. which was published in 1740, and to which is prefixed an account of his life. See our article Blind, Vol. III. p. 600.

SAVAGE, Richard, an English poet, more celebrated for his vices and his misfortunes than for his talents; was the son of the Countess of Macclesfield, and Richard Savage, Earl of Rivers. He was born in January 1697, and though Lord Rivers took upon himself the care of the boy, yet his mother, who seems to have cherished for him the most unnatural dislike, put him under the care of a poor woman, who undertook to educate him as her own child, and to keep him ignorant of the circumstances of his birth. Although he now bore the name of his nurse, yet Lady Macclesfield's mother paid him some concealed attention, and contrived to have him placed at the school of St. Albans. Lord Rivers was at that time on his death-bed, and having expressed his resolution to leave Richard £6000, Lady Macclesfield frustrated his design by telling him that he was dead. Having failed in a scheme of sending this unfortunate youth to the plantations in North America, he was bound apprentice to a shoemaker. The death of his supposed mother gave him an opportunity of perusing some letters, which disclosed to him the secrets of his birth. Quitting his humble profession, he sought by every means in his power to conciliate the affections of his mother, who had now married Colonel Brett; but she spurned him from her with the most unnatural harshness, and on one occasion, when he had walked into her house, impelled by a resistless curiosity to see the being to whom he owed his existence, he was immediately turned to the door under the pretence that he sought her life.

Being now destitute of every means of support, Savage turned his thoughts towards literature. His first compositions were a poem and two plays, taken from Spanish comedies, and entitled, "Woman's Riddle," and "Love in a Veil;" but he gained from them no other advantage than the acquaintance of Sir

Savage, Richard.

Richard Steele and other wits. By ridiculing Sir Richard Steele behind his back, he lost his patronage, and was for a while dependant on the donations of Mrs. Oldfield the actress, who, though she supplied his wants, would never admit him into her house.

Savage now resolved upon writing a tragedy, but he was in such destitute circumstances, that he composed it in the streets, and wrote what he composed on scraps of paper picked up from the ground, and with pen and ink borrowed from the nearest shop. In that way he wrote the tragedy of "Sir Thomas Overbury," which, when corrected and fitted for the stage by Aaron Hill and Cibber, was acted at Drury-Lane in 1723. This piece had little success, though he himself acted the part of Overbury; but it produced him the sum of £200.

His next literary undertaking was a volume of "Miscellaneous Poems," to which he prefixed an humorous account of the usage he had received from his mother. The profits of this little work, which was published by subscription, raised our author above abject poverty; and the interest excited by his private history brought him into notoriety. An event, however, of a most distressing kind now occurred. In one of his drunken rambles, in November 1727, he quarrelled with a party who were just quitting the tavern which he was entering, and unfortunately killed one of them. For this crime he was tried, convicted, and condemned to death. His friends made great exertions to save his life, while his mother exerted herself as strenuously to prevent him from obtaining mercy. The Countess of Hertford, however, laid the whole case before the Queen, and succeeded in obtaining a pardon.

Justly regarding his mother as his most implacable foe, he now threatened to harass her with satirical poems, and expose her conduct, unless she allowed him a pension. This threat was successful. Lord Tyrconnel, Lady Macclesfield's nephew, took our author under his roof, treated him as his equal, and gave him an allowance of £200 a-year. Under this gleam of sunshine, Savage was courted by a crowd of young aspirants after fame. He published his "Temple of Health and Mirth" on the occasion of Lady Tyrconnel's recovery from a severe illness; and he composed the "Wanderer," a moral poem, which he dedicated to Lord Tyrconnel, in terms of the most overstrained panegyric. In this prosperous condition Savage did not long continue. He quarrelled with his benefactor, and again threw himself upon the world.

In order to execute his former threats against his mother, he wrote a poem, entitled, "The Bastard," which had an extensive sale. This poem was published at Bath, when his mother was resident in that place; and it is said that many persons disgusted at her treatment of the author, repeated passages of it in her hearing, and drove her to seek for shelter among the crowded circles of the metropolis.

Impelled by poverty, Savage now resolved to throw himself upon the munificence of Queen Caroline. He published a poem for her majesty's birth-day, entitled, the "Volunteer Laureat," in consideration of which, the queen gave him a pension of £50 a-year. This sum, however, was a small pittance for a person of Savage's prodigality. The moment he received his pension, he secreted himself in some obscure tavern, indulging in eating and drinking, and in the lowest sensuality, till the expenditure of his money forced him to emerge in search of the means for fresh excesses.

It was about this time that Dr. Johnson became acquainted with Savage; and, captivated with his politeness and powers of conversation, he sometimes accompanied him in his nocturnal rambles for the purpose of studying the character of that extraordinary person.

In consequence of the death of Queen Caroline in 1738, Savage lost his pension, and was entirely thrown upon the beneficence of his friends. A subscription was raised in order to enable him to live in retirement in Wales on a pension of £50 per annum, £20 of which was, we believe, contributed by Mr. Pope. To this plan of life he readily agreed; and in 1739 he set out in the Bristol stage coach with fifteen guineas to pay his expenses; but in place of travelling to his destination, he lingered on the road, and applied to his friends for a fresh remittance to enable him to pursue his journey. In this way he reached Bristol, from which he proceeded with great reluctance to Swansea, where he remained a year occupied in writing another tragedy on the story of Sir Thomas Overbury. Having finished this play, he resolved to return to London, but his friend Pope proposed that it should be fitted for the stage by Thomson and Mallet, and that the profits of it should be laid out in the purchase of an annuity. Savage was enraged at this proposal; he returned to Bristol on his way to London, and having experienced much hospitality and kindness, he remained till his money was spent, and till he had become so shabby in his dress, and so disgusting in his personal appearance, that nobody would admit him to their house. The mistress of a coffee-house arrested him for a debt of eight pounds, and being unable to find bail he was thrown into the jail of Bristol. Here he was treated with the greatest kindness and humanity by the jailer, who allowed him every kind of indulgence; and he composed a satire, entitled, "London and Bristol delineated," in which he treated his benefactors in the last of these cities with the basest ingratitude.

After he had spent about six months in the prison, he received a letter from Pope, accusing him of the most atrocious ingratitude; but we are not informed of the particulars of this accusation. He is said, however, to have protested his innocence of the charge, and to have been much affected by the perusal of the letter which contained it. In a few days after he was seized with a nervous fever, which carried him off on the 1st of August 1743, in the 46th year of his age.

We are almost ashamed at having occupied our pages with any notice of such a man as Richard Savage. No talents of any brilliancy, and no quality of any value redeemed the utter worthlessness of his character. His misfortunes, though owing to his own misconduct, have received a sort of romantic aspect from the unnatural conduct of his mother, but even this accidental circumstance would not have saved him from oblivion, had not the eloquence of Dr. Johnson thrown an adventitious interest round his vices and his sufferings.

SAVAGE STATE. See MAN.

SAVOY, anciently *Sabaudia*, is now one of the divisions of the kingdom of Sardinia, bounded by Piedmont on the east, by France on the west, and by the lake of Geneva on the north. It is about ninety-four miles long from north to south, and its average breadth is about 65 miles. The superficial extent of Savoy is about 3800 square miles.

This district consists of the most elevated land in Europe, embracing the interesting and highly picturesque and sublime scenery to the south of the lake of Geneva. We have already given most copious and minute descriptions of this part of Europe in our articles ALPS, BLANC, *Mont*, and *Department, Mont* CENIS, CHAMOUNI, GLACIERS. The principal towns in Savoy are CHAMBERY, the capital, which has already been described, (See Vol. VI. p. 73) Rumilly, with a population of 3000, and Moustiers and St. Jean de Maurienne, with 2000 inhabitants each.

Savoy was seized by the French in 1792; but in 1815 it was restored to the king of Sardinia.

SAUSSURE, HORACE BENEDICT DE, the son of Nicholas de Saussure, celebrated for his agricultural writings, was born at Geneva in 1740. From Conches, where his father resided, about half a league from Geneva, young Saussure went daily to Geneva to receive the rudiments of his education. His leisure hours were spent in climbing the precipices and exploring the recesses of the lofty mountains which overhung his dwelling, and he was thus led at an early period of life to devote himself to those studies which necessarily associated themselves with his early habits. His passion for natural history was greatly increased by his connexion with M. Bonnet who married his aunt, one of the family of De la Rive, and who was at that time engaged in his enquiries concerning the action of the upper and under leaves of plants, of which he published an account in 1754 in his *Recherches sur l'usage des Feuilles dans les plantes.* Young Saussure constantly took a keen interest in these researches, but he pursued the subject farther than his relation, and published an account of his labours in his *Observations on the bark and leaves of plants.*

In the year 1762, when he was only in the twenty-second year of his age, he was appointed professor of philosophy at Geneva, a situation which he held for twenty-five years. During the intervals between his lectures, he devoted himself to the examination of the mountains of Switzerland, and to those enquiries respecting their physical geography which have immortalized his name. So early as 1769, he had visited the glaciers of Chamouni, and in 1779 he had crossed the principal chains of the Alps about fourteen times in different directions. These journeys were not performed in the slovenly and ignorant manner so common among geologists in modern times. Saussure prepared himself for these expeditions by study as well as by judicious arrangements. He equipped himself with accurate instruments of every kind. He invented and constructed new ones, with which science could not furnish him; and while he attended to the phenomena of the rocks upon which he trod—to the distribution and altitude of the mountain masses which he traversed—to the phenomena of the snow and the ice with which they were covered, he studied with equal interest and success the phenomena of the blue expanse under which they lay—the electricity and humidity of the atmosphere, and those various meteorological phenomena which since his time only have occupied so much of the attention of philosophers.

In the year 1779, Saussure published the first volume of his *Voyages dans les Alps*, which contains a minute description of the neighbourhood of Geneva, and an account of his excursion to Chamouni.

During the troubles with which Geneva was agitated in 1782, Saussure devoted himself to a series of researches connected with the subject of Hygrometry. In order to carry on these, he invented his new hygrometer which, if we except Mr. Daniell's instrument, is the best that has ever been constructed. An account of these researches were published in 1783, in his *Essai sur l'Hygrometrie*, in 1 vol. 4to.*

About this time Saussure became so much occupied with his own studies, that he resigned his chair to the late M. A. Pictet who continued to discharge its duties with the highest credit and success till his death in 1825.† Saussure was now able to follow, without interruption, the pursuits to which he was so much attached, and was enabled to publish, in 1786, the second volume of his travels among the Alps, which contains an account of Mont Blanc and the surrounding mountains.

Though engrossed with his philosophical pursuits, Saussure took a great interest in the state of education at Geneva. He projected a new system, one of the principal objects of which was to make the youth acquainted with Mathematics and the natural sciences at an early period of life; but though this plan met with much approbation, it was considered to be an innovation too hazardous to be put in practice. Saussure had the merit of founding the *Society of Arts* at Geneva, to the operation of which Geneva is said to be much indebted for its present prosperity.

In the year 1788, Saussure set out for the Alps for the purpose of completing some of the researches which he had previously commenced. Along with his eldest son he encamped seventeen days on the Col du Geant, during which he was enabled to make many interesting observations both in meteorology and geology.

When his native city was annexed to the French republic, Saussure was chosen deputy to the national assembly, but however promising these events appeared to men of sanguine temperament and fond of change, the more soberminded foresaw the calamities which were to follow in their train. In the political convulsions which ensued, Saussure lost the greatest part of his fortune; and what was a greater calamity still, he lost, amid the storms of faction, that tranquillity and peace of mind which constitute the patrimony of a philosopher. His health was rapidly affected by the distresses which he experienced in common with his country, and in 1794, a severe paralytic affection deprived him of the use of his limbs. His mind, however, though disturbed, was still active, and sought to forget its afflictions in the preparation of his travels for the press, the two last volumes of which appeared in 1796. About this time he also published his *Observations on the Fusibility of Stones by means of the Blowpipe*, an instrument, the value of which, first pointed out by Gahn, had scarcely been recognised in the south of Europe. The health of Saussure was now so far gone, that the aid of the ablest physicians could give him no relief. His powers of articulation were now greatly affected. His mind lost its vigour, and he died on the 22d of March 1799, in the 59th year of his age, deeply lamented by all who knew him.

Saussure left behind him two sons and a daughter, whose education he superintended with the greatest care. His eldest son, Theodore de Saussure, is well known by his talents, and his chemical researches.

Besides his hygrometer, which we have already mentioned, Saussure invented the CYANOMETER,‡ invented for measuring the blue colour of the sky; a DIAPHANOMETER,|| for measuring the transparency of

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* An account of Saussure's Hygrometer and of his principal experiments, will be found in our article HYGROMETRY, Vol. XI.

† A biographical account of this distinguished individual will be found in Dr. Brewster's *Journal of Science*, No. IX.

‡ See CYANOMETER, Vol. VII. p. 532.

|| See DIAPHANOMETER, Vol. VII. p. 727.

the atmosphere, and an ELECTROMETER[*] for measuring small degrees of electricity. An account of his experiment on the electricity produced by evaporation,[†] on the electricity of the human body, and on the electricity of the atmosphere, have been detailed at great length in our article ELECTRICITY, Vol. VIII. p. 427, 463, 479, and 481.

Although the principal part of Saussure's life was devoted to the examination of the Alps, yet he found leisure to pay two visits to France, one for the purpose of studying the extinct volcanoes of Auvergne, and the other to make himself acquainted with the practice of aerostation. He likewise paid a visit to England, where he became acquainted with Dr. Franeker. During a journey to Italy he visited the iron mines of Elba; he measured the height of mount Etna, and he ascended Vesuvius in company with our countryman Sir William Hamilton. Saussure was also fond of botanical pursuits. He discovered several new species of lichens, and two kinds of tremella having an oscillatory motion; and yet no genus has been dedicated to his name. In our articles ALPS, Vol. I. and CHAMOUNI, Vol. VI. p. 732, our readers will find many of Saussure's opinions and descriptions of scenery.

SAWING MACHINERY, or SAW-MILLS, is the name given to all kinds of machines used for cutting into pieces solid bodies, such as wood, stone, &c.

Saw-mills seem to have been erected so early as 1420 in the island of Madeira. At Breslau, a saw-mill was erected in 1427; and they were afterwards rapidly introduced into different parts of Europe.

A saw-mill, driven by wind, was erected at Leith about the middle of last century; and in 1767 or 1768, when a saw-mill was erected at Limehouse, it was demolished by the mob.

Common saw-mill.

PLATE CCCCLXXXII. Fig. 1.

In giving an account of sawing machinery, we shall first describe the common saw-mill, which has been long in use. This machine is represented in Fig. 1. Plate CCCCLXXXII. No. 11. where BB is a bucket wheel about 18 feet in diameter, and having about 40 buckets. This wheel is fixed on the axle AA, in which there is also placed a wheel CC, having 96 teeth. This wheel drives a pinion, marked 2, with 22 teeth, which pinion is fixed on an iron axle, having a coupling box at each end, that turns round the cranks D, D. The vertical pole E has its lower end put on the crank, while its upper end moves on an iron bolt at F, the lower end of the frame G G. These frames, which contain the saws, are thus made to move up and down by the motion of the crank. The pinion, marked 2, may give motion to two, three, or more cranks, and may thus drive as many saws with their frames. A ratchet wheel, No. 3. is fixed, as shown in the figure. Its angular teeth are laid hold of by the end K of the iron hook HK, the other end of which moves on a bolt in the lever HH. The end of this lever moves on a bolt at I, and the other rests on a notch in the frame GG, so that it rises and falls with the frame. When HH is raised by the frame GG, the catch K pulls the wheel round towards it, and the catch Z falls into the teeth, so as to prevent the wheel from going backwards. Upon the axle of the wheel 3 is fixed a pinion 4, which works on the toothed rack of the frame TT, which carries the wood to be sawed. As the ratchet wheel, No. 3. therefore, turns round, it carries the frame T,T, which carrying the wood advances on its rollers S, S, along the fixed frame UU, so as to come up against the saws as they are moved up and down by the crank DD. The ordinary apparatus for raising the sluice and letting on the water, is shown at VV; but a self-regulating one, such as that described in our article HYDRODYNAMICS, Vol. XI. p. 561, is used in all great establishments. By pulling the rope at the longer end of the lever M, the pinion 2 is connected with the wheel CC, which drives it, and, by pulling the rope R, they are separated from one another. In order to roll the frame TT backwards when it is empty, the pinion 5, with 24 teeth, and driven by the wheel CC, has upon its axle a sheave, over which is put the rope PP, which goes over the sheave O, and turns it round. Upon the axle of the sheave 6, is fixed the pinion 7, which acts on an iron rack upon the frame TT, and drives it backward. The pinion 5 is connected with the wheel CC, by pulling the rope at the lower end of the lever N; and they are separated from each other by pulling the rope O. In order to drag the logs of wood in at the door Y, there is fixed upon the axle 9 a wheel 8, having ratchet teeth on its rim, into which the catch 10 enters; and as this catch is raised by the lever at the upper end of the frame GG, it pushes round the wheel 8, which is prevented from moving backwards by the catch No. 11. falling into its teeth. The rope 9 Y is, therefore, coiled round the axis 9, and thus drags the logs in upon the frame TT. The catches 10, 11 are thrown out of play when the logs are laid upon the frame.

Very great improvements have been made on sawing machinery by that celebrated engineer, Mr. Brunel. In our article on BLOCK MACHINERY, Vol. III. p. 608, we have already given a description of several of the sawing engines, which form part of the machinery for manufacturing blocks, and we shall now confine ourselves to an account of the most important of his improvements.

One of Mr. Brunel's saw-mills was constructed by Mr. Maudslay, for the arsenal at Woolwich. It is driven by a steam-engine; and the whole is considered as a pattern of the best, as well as the most elegant workmanship.

In this machine leather belts are substituted most properly in place of cog-wheels; and in order to equalize the motion of the cranks in the most perfect manner, each crank has a fly-wheel attached to it, independent of the great fly-wheel of the steam-engine.

In the construction of the saw-frames Mr. Brunel has shown much ingenuity. They are all made of iron, but the sides are left hollow, and are filled up with wood, in order to diminish the weight.

As it is of essential importance that the saws be placed parallel to each other, and stretched with the very same degree of tension, Mr. Brunel has effected this in the following ingenious manner. The saws are fitted into the frame, so that they can be quickly removed and replaced by sharp ones. Each saw has a piece of metal rivetted to each end of it, and formed like hooks. The hook in the lower end is hooked into a suitable recess in the lower cross bar of the saw-frame, and the hook at the upper end seizes the hook of a shackle or link which hangs upon the upper cross bar, and has wedges through it, by which it can be drawn tight to strain the saw. As there is nothing to determine the parts of the cross-bars, where the hooks of the saws may hang, the saws can be set at any required distance from each other; but in order to retain them, pieces of hard wood are put in between the blades of the saws at the upper and lower ends; and when the spaces are thus filled up, they are kept tight by screws tapped in the sides of the saw-frames. Each saw is strained in succession by a steel-yard, constructed as follows. A strong axis goes across the fixed frame in which the saw-frame slides; and above the top of this frame from one side of this axis proceeds a lever, which has a weight fixed at the end, and from the opposite side of the axis proceed two short levers, which are connected by links with a strong cross bar, situated immediately above the upper cross bar of the saw-frame, when it has reached its highest elevation. Upon the steelyard cross bar is a shackle or link, which can be united by a key with any of the shackles on the upper cross bar of the frame, which shackles, as we have already said, are united by their hooks with the upper end of their corresponding saws. By this means the lever with its weight becomes a steelyard, by which any one of the saws may be drawn up with a given force.

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[*] See ELECTRICITY, Vol. VIII. p. 522.

[†] This subject has been recently pursued by M. Becquerel. See Dr. Brewster's Journal of Science, Vol. III. p. 370.

In order to apply the steelyard, the frame is raised to its greatest height, and wedges are then put in between the top of the saw-frame and a fixed part of the stationary frame, so that the saw-frame may be kept fast when the steelyard is applied. The sharp saws are now put into the saw-frame by hooking them on the lower cross bar, and uniting the upper hooks to the shackles on the upper cross bar. The pieces of wood are then introduced between the saws, according to the size of the wood, and they are bound fast by screws. The loaded end of the steelyard is now lifted up by a rope going over a pulley, so as to allow the link in the cross bar of the steelyard to be united with the shackle of one of its saws by its keys. The steelyard being now allowed to descend, it stretches the saw with a force depending upon its load. The wedge of the shackle for the saw is then thrust in by the hand as far as possible, so as to retain the saw at the tension given to it by the steelyard. The shackle of the steelyard is then disengaged from the saw and removed to the next, which is stretched in a similar manner.

In this saw mill, there is a contrivance by which each saw frame is allowed to retreat a small quantity in its ascent, in order that the teeth of the saws may keep quite clear of the wood when they ascend and do not cut.

Circular saws, or saws of a circular form, which cut during a continuous rotatory motion, have been used for cutting the teeth of watch and clock wheels since the time of Dr. Hook. They have been long used in Holland for cutting veneers, and they are said to have been introduced into this country by General Bentham. Mr. Taylor of Southampton, and Mr. George Smart, had the merit of introducing them very early; but we do not know the exact dates.

A circular saw is nothing more than a circular plate of steel, having teeth upon its circumference, and made to revolve upon an axis with great rapidity, by means of bands or straps. The saw itself may move either on a horizontal, a vertical, or an inclined plane; and as the timber may be laid upon a plane inclined in any given direction, it may be sawn in lines making any angle whatever, or at any given distance from one another. When the saw is fixed at a certain angle and at a given distance from the edge of the frame, all the pieces of wood may be cut exactly of the same size, by pressing them against the edge as the saw is cutting them. The following is a description of the circular saws at Rothiemurchus in Inverness-shire.

There are two kinds of saws made use of in the Rothiemurchus saw-mill, circular saws and upright ones. A circular saw is a thin round plate of steel; toothed on the circumference fixed on a revolving axle. An upright saw is the common saw made use of by sawyers, fixed in a frame moving vertically. In both cases, the log to be sawn is fixed to a frame, which is moved against the saw. Each of these constructions has peculiar advantages. The upright saw, it is evident, cuts only in descending; there are also two points in every stroke at which it is stationary, the one when it is at its height, the other when at its lowest. A large proportion of the time of each stroke is thus consumed without effect. A circular saw cuts during the whole of its revolution; and it is found that a much greater velocity can be given to a circular motion, which is equal and constant, than to an upright one, which is necessarily unequal. A circular saw is thus much more expeditious than an upright one. It is, however, much more limited in its application, as it can only work in wood of less depth than the radius of the saw. The size of wood is further controlled by the thick plates of metal which are made use of to fix the saw on its axle. These *flaunges*, as they are called, it is found by experience, require to be about one-third of the diameter of the saw. Besides this, the size of the saw itself is controlled by the thickness required to give the plate sufficient stiffness. A circular saw, too, one-eighth of an inch thick, would occasion much loss in saw draft. In this mill no saws have ever been used above three feet diameter.

Circular saws.

The application of upright saws is controlled only by the length of stroke given to the saw frame and its size; the stiffness of the saws is given by stretching them tightly between the upper and lower ends of the frame, and is therefore in a great degree independent of the actual size of the saw.

The intention in this mill is to saw by circular saws, where they would not occasion too great a loss in saw draft; and in this case only, to saw by upright ones.

The circular saws run about 1000 turns per minute, and will cut 10 inches deep on 3-16ths of an inch of saw draft. The upright saws make about 120 strokes per minute, and will run on *rather less* saw draft.

The circular saws will cut a 12 foot log in less than a minute; the upright saws in equally fine work, will not cut above 15 inches in the same time.

In the process of making deals with circular saws, the first operation is called slabbing; it is to reduce the tapering round log into a plank as thick as the deals are intended to be broad. This is done by running two saw-drafts parallel to each other through the log, which produces a flat-sided round-edged piece of timber of equal thickness, but tapering in breadth. The slabbed log is then cut into deals of the required thickness, by running the saw through it as often as is necessary at right angles to the former saw drafts.

Plate CCCCLXXXII. Figs. 2 and 3.

In this mill the slabbing is performed by two saws fixed on the same axle, S, S, Figs. 2. and 3. the distance between which regulates the thickness of the slabbed log. A plank or batten B, so narrow as to pass freely between the saws when at the *least required distance* from one another, is laid parallel to the face of the saws in the centre between them. A broader plank D, E, is laid parallel to this batten on the outward side of each saw, as far apart as to pass the saws freely when at the *greatest required distance* from one another. These three planks are connected together by cross pieces A, C, at the ends, and being laid on rollers R parallel to the axle of the saw, form a table, moveable backwards and forwards, limited in either range by the connecting cross-pieces coming against the saws. This travelling table is

Sawing Machinery.

Plate ccccLXXXII.

moved by a pinion working in a rack, which is inserted on the under side of one of the broad planks. The power is raised as necessary, by a smaller pinion working on the larger, and put in motion by the hand of the workman by means of a winch W. On the farther end of the batten is fixed a head-stock H, a few inches high; and a grapple GJ, turning on joints at J, and having a cross-head at G, into which three teeth are inserted, G, G, G. Fig. 4 shows this grapple on a larger scale.

Fig. 4.

Before the log is put on, the travelling table is moved back, as shown in Fig. 1, 2, and the log is laid free of the saws on the batten, one end pressing against the head-stock, and the grapple teeth driven firmly into it. These keep the log steady under the action of the saws. The workman then moves the travelling table forward against the saws, till they have run through the log; he then returns the table to the position shown in the figures, removes the slabbed log and outside cuts, and is ready to begin to a fresh log.

The distance between the saws can be indefinitely varied between the width of the batten, which is the minimum, and the space between the side planks, which is the maximum.

Figs. 5, 6.

The axle DKE, Figs. 5 and 6, is turned accurately cylindrical, and the flaunches A, B, C, are drilled through in the centre, so as to allow them to be moved along the axle and no more. When the saw is placed at the desired point, a key is driven tightly in to a taper mortice made through the flaunches at K, which prevents the saw from shifting its position. The saws can also be changed by the same contrivance, and it is adapted to all the circular saws in this mill.

Fig. 6.

The next operation is, converting the slabbed log into deal. The slabbed log is laid flat on the side B (Fig. 6.) of the travelling table ABCD, the end of it against the head-stock H, from whose face a few sharp points stick out, which enter the end of the log, and keep it firm. For the first saw draft which takes off the round back, the log is set by the eye. The travelling table is moved forwards as before, the back taken away, and the table returned to the position in the figure.

On the side D of the travelling frame is placed a guide G a few inches high, moving on parallel points, as shown in the figure, so as in every situation to continue parallel to the saw. This guide is set by the hand to the distance from the saw, equal to the intended thickness of the deal, and kept in this situation by a ram's-head nut, as it is termed, screwed down tight on one of its points. The log is then placed with its face against the guide, and its end fixed to the head-stock as before. The table is moved forwards, and a deal of equal thickness cut off.

Fig. 7.

The way in which the saws are put in motion is shown by Fig. 7.

ABC is the spur-wheel, hung on the same axle with the water-wheel. The water-wheel is not shown. This spur-wheel works in a pinion BDE, on the same axle with which are hung as many drums as there are saw axles to be put in motion. Only one is shown in the figure, GEH. This drum turns by a strap, an intermediate drum IKLM, which by another strap turns the pulley P of the same size, placed perpendicularly over it, on the axle of the saw.

The intermediate drum is hung in a frame, which is raised or lowered by means of a rack and pinion, worked by the hand in the mill above. The use of this is to stop any of the saw axles, without stopping the machine; and the contrivance is very simple.

When the intermediate drum is raised to the situation *iklm*, it is evident the strap NCLMI will only touch the intermediate drum in the points L and *i*, and consequently will not be put in motion by it; and the pulley P, together with the saw axle on which it is hung, will stop. The other strap GKLMH suffers so slight an alteration in tightness by the motion of the intermediate drum, that it turn it as before.

Fig. 8 shows the intermediate drum, its frame, and rack. The shaded part of the figure shows the grooved posts between which it moves. The pinion that works in the rack is not shown. It is put in motion by a capstane at the other end of its axle, and kept in the desired situation by a common catch.

Fig. 9 shows a contrivance for returning the travelling table by the machine, which is more expeditious than the hand. AB an axle, set in motion by a strap from the principal drum axle on the fast pulley F. L a loose pulley on the axle AB, round which a rope is wound, passing over the roller R, at the end of the frame of the travelling table T, to which the rope is fastened. The loose pulley, when out of gear, as shown in the figure, allows the rope to be unwound freely as the table is moved forward. When it is to be put in gear, it is moved by the levers C, D, E, G, H against the fast pulley, which carries it round by means of the iron knobs shown in the figure. The rope is then turned round the pulley, and the frame dragged back.

An improvement in the mode of fitting up circular saws was made by Mr. Maudslay. When the pivots at the end of the axle were conical, or when there were conical hollows on the end of the axles working upon fixed cones, the oil was always carried up the cone by the centrifugal force, and the sharp point being left without oil, soon heated, and caused the metal to become soft. In order to avoid this, Mr. Maudslay made his saw spindles with double conical sockets, and the oil was introduced by a small hole into the smallest part of the double cones where they join. By this means the centrifugal force draws the oil into the fitting.

In order to prevent thin circular saws from bending, or *buckling* as it is called, they are confined between two flat circular plates: but in place of doing this, the bending is now confined to a more narrow ring near the rim of the saw. By this contrivance, the saw revolves with such truth and accuracy, that it is fit for the nicest operations, such as cutting the teeth of the finest cones. It is considered advantageous to soften circular saws when the teeth require sharpening, and to temper them only to a yellow colour. See Dr. Brewster's *Journal of Science*, No. III. p. 151.

SAXE, Maurice, a celebrated general, was born at Goslar, on the 13th Oct. 1696, and was the natural son of Frederick II. Elector of Saxony, and King of Poland, and of the Countess of Konigsmar, a Swedish lady, distinguished by her beauty and accomplishments.

His passion for a military life displayed itself at a very early period, and it was with the greatest difficulty that he could be taught to read and write. At the early age of twelve, he served in the allied army under the Duke of Marlborough and Prince Eugene. In 1708, he accompanied the same troops at the *siege of* Lisle. He distinguished himself at the sieges of Tournay and Mons; and at the memorable battle of Malplaquet, and on various occasions, he received the highest eulogiums from the allied generals. In 1711, our young warrior accompanied the king of Poland to the siege of Stralsund, where he swam across the river in sight of the enemy with a pistol in his hand. In consequence of the courage which he displayed on that occasion, a regiment of cavalry was raised for him, at the head of which he fought against the Swedes at the bloody battle of Gadebusch, where he had a horse killed under him, after he had thrice rallied his regiment, and led them on to the charge.

When this campaign was finished, his mother prevailed upon him to marry the Countess of Loben, a lady of wealth and beauty. This union, however, was not a happy one, and was dissolved in 1721. Their only child died in infancy; and the licentious habits of Count Saxe unfitted him for the enjoyments of domestic life.

In the war against the Turks, he accompanied Prince Eugene into Hungary, with 15,000 men. He was present at the siege of Belgrade, and at another battle gained over the Turks; and on his return to Poland in 1718, he was decorated with the golden eagle.

After the general pacification of Europe, he took up his residence in France, where the Duke of Orleans, then regent of the kingdom, honoured him with a brevet of Marechal de Camp. Resolved to devote himself to the study of his profession, he resumed with ardour his mathematical pursuits, and made himself master of the various improvements in military tactics. Having got the command of a German regiment in France, he drilled them in a new kind of exercise, which was considered a favourable presage of his future greatness.

When the dukedom of Courland became vacant in 1725, the states of Courland chose Marshal Saxe for their sovereign; but his election was opposed both by Russia and Poland. Prince Menzikoff, the Russian candidate, sent 800 Russians to Mittau, where he besieged the Marshal in his palace; but such was the intrepidity with which he defended himself with only sixty men, that the Russians were obliged to abandon their scheme of taking him prisoner. Finding it in vain to contend alone with such powerful enemies, he applied to France for men and money. The celebrated actress, Mademoiselle de Couvreur, pawned her jewels and plate, in order that she might send him 40,000 livres; but this assistance was inadequate to his wants, and he was therefore obliged to quit Courland, and return to France. The Duchess of Courland, who afterwards sat on the Russian throne, flattered him with the hopes of her hand, but finding herself unable to fix his affections, then under the dominion of Mademoiselle de Couvreur, she abandoned all thoughts of the match.

In the interval which succeeded these disappointments, Marshal Saxe again devoted himself to literary pursuits. He not only resumed his mathematical studies, but in the course of thirteen nights, during the intervals of an ague, he composed his "Reveries;" a work containing many new ideas on military subjects.

Upon the death of his father, the king of Poland, in 1733, the talents of our hero were again called into action. From a partiality for the French service, he declined the command of the Saxon troops, which had been offered him by his brother; and he joined the Duke de Berwick's army, which was then encamped on the Rhine. The general, who was at this moment preparing to attack the enemy's entrenchments at Etlinghen, exclaimed, on the Count's arrival, "I was about to send for 3000 men, but your arrival is of more value than them." This compliment was not misplaced. At the head of a regiment of grenadiers he penetrated the enemy's ranks, and decided the fate of the day. At the siege of Philipsburg he exhibited equal valour; and from his great merits, he was raised to the rank of lieutenant-general in 1734.

After the short peace of 1736, a new war was caused by the death of Charles VI. Count Saxe took the city of Prague by assault in 1741; and Egra submitted to his arms a few days after the trenches were opened. In consequence of this success, Charles VII. wrote a letter of thanks to the Count with his own hand.

When the King of France invaded Flanders in person in 1744, and had obtained the most signal success, he was obliged to quit the scene of his triumph, in order to check the advance of Prince Charles of Lorraine, who had entered Alsace. He therefore left Marshal Saxe to watch the motions of the enemy, a duty in which he displayed the most consummate generalship.

In 1745, though in very bad health, he gained the celebrated battle of Fontenoy, of which we have already given an account in our article BRITAIN, Vol. VI. p. 627.

In the campaign of 1747 and 1748, he acquired additional honour. On the 11th Oct. 1746, the King of France sent him a present of 6 pieces of cannon; on the 12th Jan. 1747, he was created Marshal of the French armies; and, in 1748, he was intrusted with the command of the French conquests in the Netherlands.

After the peace of Aix-la-Chapelle, to which these victories led, Marshal Saxe retired to Chambord, an estate which was presented to him by the King of France, and he spent his leisure hours in the most agreeable manner in the society of philosophers, men of letters, and artists. He was induced some time afterwards to pay a visit to the King of Prussia, by whom he was received with the highest honours.

Exhausted with the labours of a military life, he was carried off by a fever on the 30th Nov. 1750, in the 54th year of his age. Though licentious in his habits, Marshal Saxe was firmly attached to the Lutheran religion, in which he had been brought up; and when the Queen of France heard of his death, she expressed her regret that they could not "say a single *de profundis* for a man, who had made them sing so many *te deums*." In his will, dated at Paris, March 1, 1748, he directed his body to be buried in quick lime, that "nothing but the remembrance of him among his friends might remain." The body, however, was embalmed, and his heart deposited in a silver gilt box. His body was interred in the Lutheran church of St. Thomas, at Strasburg, on the 8th Feb. 1751, and the expences of his funeral defrayed by Louis XV.

Marshal Saxe, though a man of ordinary stature, was remarkable for great strength and a robust constitution. Along with a warlike mien, he possessed great mildness of expression. He was affable and generous even to excess. In his last illness he declared that "his life had been a fine dream;" and he expressed much penitence for the licentiousness of his life.

The best edition of his *Reveries* appeared at Paris in 1757, in two vols. 4to, accompanied with several engravings, and a life of the author. For a full account of the biography of this eminent general, see his life by M. d'Espagnon, in 2 vols. 12mo. and Marechal de Saxe's *Lettres et Memoires*, Paris 1796.

SAXONY, a kingdom in the north-east of Germany, bounded on the north, north-west, and north-east by Prussia; on the south and south-east by Austria; on the west by the principality of Reuss and Saxe Gotha; and on the south-west by Bavaria. The dominions of the Elector of Saxony were established into a kingdom in 1807 by Bonaparte, who enlarged it by the addition of Prussian Poland, and by considerable portions of the Austrian states. This additional territory, however, was restored to Prussia and Austria at the congress of Vienna, when the kingdom of Saxony was composed as it is at present of the following divisions:

Saxony.

	Extent in square Miles.	No. of inhabitants in 1817.	Capitals.
1. Circle of Meissen	1600	300,000	Dresden.
2. Circle of Leipsic	1460	207,000	Leipsic.
3. Circle of Erzegebirge	2175	460,000	Freiberg.
4. Circle of Vogtland	700	90,000	Plauen.
5. Circle of Lusatia	1180	170,000	Bautzen.
	7115	1,227,000	

The general form of the kingdom of Saxony is triangular, the longest side of which is on the frontiers of Bohemia, from which it is separated by a long range of mountains stretching in a south-westerly direction.

The surface of the northern part of Saxony is in general of a level or gentle undulating character; but in the south it rises into three successive ridges of mountains, called the Vorgeberg, the Mithelgeberg, and the Hochgeberg. The following are the elevations of their most lofty summits:

The Fichtelberge	3730 feet.	Lausche .	2400 feet.
Auersberg . .	2931	Hochweld .	2299

A portion of the mountainous region which lies between Dresden and Bohemia, has received the appellation of Saxon Switzerland, from the similarity of its scenery to that of the Helvetian Alps. It is about 28 miles long and 23 broad. The Elbe forces its way through this elevated region, at the base of precipices 1000 feet high. The almost impregnable fortresses of Koenigstein, Litherstein, and Lillienstein, situated on elevated rocks, display all the resources of modern fortification.

The kingdom is about 140 miles long, its maximum breadth about 75 miles, and its extent in English acres is about 2,620,000.

Rivers.

The principal rivers in Saxony are the Elbe, the Black and White Elster, the two Muldas, and the Pleisse, all of which, except the Elbe, (see ELBE, Vol. VIII. p. 407,) have their sources in the south of the kingdom, but are not navigable within its limits.

Agriculture.

The principal agricultural districts in Saxony are the circles of Meissen and Leipsic, where the land is well cultivated, and produces wheat, barley, oats, and other grains in abundance. Tobacco, hops, flax, anise seed, woad, &c. are also raised; and in Meissen some wine is made in favourable situations. In the southern mountainous districts there are extensive forests, which yield good timber and pitch, but which are maintained principally for the purpose of supplying the miners with fuel. Coals, which are found in several places of the country, and turf, are used by the people in various parts for domestic fuel.

Wool has long been one of the staple commodities of Saxony, great attention having been for a long time bestowed on the breed of sheep, and Merino lambs having been introduced about the year 1768.

Minerals.

Saxony has long been celebrated for its mineral waters, which have been found principally in the lofty range of the Erzegebirge. The basis of this range is granite, upon which rest gneiss, mica and clay slate. Basalt in regular columns occur in various parts. There are a few silver mines here. Iron is found in the primitive mountains, and copper and lead in the secondary ones. Arsenic, cobalt, tin, cinnabar, mercury, bismuth, antimony, &c. are also found. Among the valuable stones, are topazes, amethysts, chrysolites, garnets, tourmalines, and all the varieties of the quartz family, such as agates, cornelians, &c. The porcelain earth found in the neighbourhood of Meissen gave rise to the celebrated porcelain manufactory of Meissen, which we have already described in our article PORCELAIN, in p. 102 of this volume.

Manufactures.

Saxony has long possessed extensive manufactories of woollen goods; and the weaving of linen is carried on to a great extent. At Chemnitz, Plauen, &c. cotton spinning is extensively carried on. Leipsic contains some silk manufactures. In our articles CHEMNITZ, DRESDEN, and LEIPSIC, will be found an account of various other Saxon manufactures.

Freiberg is a town highly interesting for its institutions and manufactures connected with the rivers of the district. There is here a mining academy, of which M. Mohs is now professor, having succeeded to Werner. Connected with that institution, there is a cabinet of minerals and of natural history. There is here a manufacture of false lace, carried on by M. Thiele, and occupying 1000 persons. The 103 mines wrought in the canton of Freiberg yielded in 1749, 49,714 marcs of coined silver, and in 1800, 45,949.

The net produce of all the Saxon Erzegebirge from 1761 to 1801, amounted to 22,447,738 rix-dollars. The house of Amalgamation is about a league from Freiberg. About 60,000 quintals of ore yield here from 28,000 to 30,000 marcs of silver, and there are laid up annually for the use of that establishment 10,000 voies of wood. See *La Description de tous les Travaux tant d'amalgamation que de fonderie qui sont en usage dans les atteliers de Halsbruck pres de Freiberg, par M. Fragoso de Sigueiro.* Dresden, 1800.

The want of inland communication is unfavourable to the trade of the kingdom, the ordinary method of transport being by waggon, and the roads being in general not good. The principal articles of export are wool, linen, and woollen goods, yarn, tar, and minerals. The chief articles imported are silk, flax, cotton, coffee, sugar, wine, and corn in plentiful seasons.

Although the royal family of Saxony are Catholics, having abjured the doctrines of the Reformation in 1697, in order to obtain the crown of Poland, yet there is a great majority of Lutherans in the population. The Catholics indeed amount only to 40,000. Leipsic is now the only university seat in Saxony. The establishments for education are numerous, and under good regulations, and the lower classes are in general taught reading and writing. There are endowed classical schools at Meissen, Wurzen, Grimma, &c.

In Saxony the sovereign shares the legislative power with the states. The states consist of two houses, the one being formed of the bishops and nobility, and the other of landholders and deputies from towns. There is here a cabinet council, a board of finance, a military court of appeal, and an upper ecclesiastical court.

The revenue of Saxony has been estimated at one million and a quarter sterling. The public debt is £3,700,000 sterling, and the military force on the peace establishment 10,000.

The following are the principal towns in Saxony, with their present population.

Dresden, - -	50,000	Schneeberg -	4,500
Leipsic, - -	33,000	Annaberg, - -	4,300
Chemnitz, -	11,000	Hennersdorf, -	4,300
Bautzen, - -	11,000	Eylau, - -	4,300
Freiberg, -	10,500	Zwickau, - -	4,000
Zittau, - -	7,200	Dobeln, - -	4,000
Plauen, - -	6,000	Tschopa, - -	3,800
Meissen, -	6,000	Perna, - -	3,800
Ebersbach, -	5,000	Grimma, - -	3,000
Mittweyda, -	5,000		

The history of Saxony has been so much interwoven with that of the other nations of Europe, that we must refer our readers for a farther account of it to our articles ANGLO-SAXONS, AUSTRIA, BRITAIN, ECCLESIASTICAL *History*, FRANCE, &c.

SAYPAN. See LADRONES, Vol. XII. p. 599.

SCALES, See ARITHMETIC, Vol. II. p. 409.

SCALES. See DRAWING INSTRUMENTS, Vol. VIII. p. 142, and NAVIGATION, Vol. XV. p. 171, 172.

SCALIGER, JULIUS CÆSAR, a celebrated scholar, and the author of various learned works, distinguished more by their erudition than by any marks of genius. He was born at Verona in 1484, and he died in 1558, in the 75th year of his age. His treatise *De Arte Poetica*, which appeared in 1561, and his philosophical work *De Causis Linguæ Latinæ*, which was published in 1540, are the ablest of his productions.

SCALIGER, JOSEPH JUSTUS, the son of the subject of the preceding article, was born at Agen in 1540, and died at Leyden in 1609, at the age of 69. He was a man of great learning, and was acquainted with thirteen languages. His principal work *De Emendatione Temporum*, which first appeared at Paris in 1587, contains a complete system of chronology, founded on fixed principles. His *Thesaurus Temporum* is a sort of supplement to that work. It appeared in 1658, in 2 vols. folio. Scaliger invented the Julian period.

SCALPA, a small island of the Hebrides, between the Isle of Skye and the mainland. It is almost a single mountain, the base of which is about five miles long, and from two to three broad.

SCAMMONY. See CHEMISTRY, Vol. VI. p. 128, and MATERIA MEDICA, Vol. XIII. p. 353.

SCANDINAVIA. See DENMARK, NORWAY, and SWEDEN.

SCAPOLITE. See MINERALOGY *Index*, Vol. XIV.

SCARABEUS. See ENTOMOLOGY *Index*, Vol. IX.

SCARBA, an island of the Hebrides, lying between Jura and Lunga. It is of a circular shape, and above three and a half miles in diameter, resembling a single mountain, which rises to the height of 1500 feet. A narrow strait divides it from Lunga, and it is separated from Jura by the famous whirlpool of Corrybhreaccan, which we have already fully described in our account of JURA, Vol. XII. p. 400. Scarba contains about fifty inhabitants.

SCARBOROUGH, a sea port and market town of England, in the North Riding of Yorkshire. The town is beautifully situated in the recess of a fine bay, and rises from the shore in the form of an amphitheatre. The old or upper town consists of two or three small streets, intersected by others of the same kind; and the new or lower town contains many handsome and well-built houses, several of which are appropriated for lodging houses. The new buildings on the cliff have a particularly fine situation, with a fine terrace in front raised about 100 feet above the sands.

Although Scarborough had once four churches, yet St. Mary's is now the only church in the town. It is a large and spacious building, containing several marble monuments. There are here chapels for the Baptists, Independents, Quakers, Methodists, and Roman Catholics. Scarborough has also a theatre and assembly-room, which in summer are open on alternate evenings. The charitable institutions are St. Thomas's hospital for aged and infirm persons; an amicable society, which educates and clothes 70 boys and girls; a seaman's hospital, a spinning school, and a school on the Lancasterian principle.

Scarborough was in former times defended by an ancient castle, situated on a stupendous rock, rising 300 feet above the level of the sea, which washes it on the north and south-east sides of its base. The site of the castle occupies about fifteen acres, and it is entered on the west side, which is lofty and precipitous, by a gateway, within which are the remains of an outwork. On the inside of this is a bridge over a deep ditch, which leads to the keep tower, which is a lofty square building, with an embattled parapet. The walls are twelve feet thick. A great deal of the fortress has fallen to ruins, and a considerable part of it was taken down to make room for barracks and a battery of twelve pounders for the defence of the harbour.

The harbour is large, commodious, and of easy access, and admits ships of large burden. It is protected by a large pier, stretching into the sea with a long semicircular sweep. The foundation is 60 feet broad, the top 42 feet, and the height 40 feet. Some of the stones weighed from 20 to 36 tons. The shipping of this port is estimated at 30,000 tons. The principal exports are corn, butter, hams, and salt fish; and its imports are coals, timber, deals, hemp, flax, iron, brandy, Geneva wine, groceries, &c. The drying and pickling of cod fish occupies a great number of hands. There is also a great manufactory of sail cloth in the town.

Scarborough owes its present prosperity chiefly to the mineral spa which attracts a great number of visitors. It was discovered so early as 1620, and is celebrated for its cure of chronic and cutaneous diseases. The following is an analysis of the two wells.

Southern Purgative Well.	Grains.	North or Chalybeate Well. Grains.
Sulphate of magnesia,	128	98
Muriate of magnesia,	16	14
Carbonate of lime,	28	61.5
Carbonate of iron,	2.6	3
Sulphate of lime,	58.4	54.4
Muriate of soda,	4	2.1
	237	233
Carbonic acid gas in a gallon,	98 oz.	100 oz.

The corporation consists of two bailiffs, two coroners, four chamberlains, and thirty-six common councillors. It sends two members to parliament. Population in 1821, 8533; number of houses 1830. See Hinderwell's *Hist. and Antiq. of Scarborough*, 4to. York, 1798; *Beauties of England and Wales*, vol. xvi. 347; *Phil. Trans.* No. 85; and Elliot *on Mineral Waters*, p. 187.

SCEPTICS. See ACADEMICS and METAPHYSICS.

SCHAFFHAUSEN, a town of Switzerland, and capital of a canton of the same name. It is situated on the right bank of the Rhine, near the frontiers of Suabia. The streets are very irregular, and though the town contains many well-built houses, it is by no means handsome. Several of the houses which are generally four stories high, are painted in front with various figures; and one of them which we noticed, was completely covered with male and female figures. The principal public edifices and establishments are the church of St. John, which is a large building, with side aisles and a large square tower; an academy, in which there are seven professors and several assistants; the market house, the hotel de ville, the public library and an arsenal built on a hill at the end of the town. It has six gates, three suburbs, and four churches. The principal manufactures of the place are cotton, silk, and leather; and there are several saw-mills near the town. A considerable transit trade has been long carried on here on account of the obstruction of the navigation of the Rhine by the great cataract of Lauffen, a little below the town. Goods brought down the river are consequently either carried to the interior or to Rhinfelden, where the Rhine again becomes navigable. The celebrated wooden bridge of Schaffhausen, which was burned by the French in 1799, has been fully described in our article BRIDGE, Vol. IV. p. 538, and represented in Plates LXXXIX and XC. It has been replaced by a plain uncovered wooden bridge 345 feet long and 21 wide, with two stone piers in the middle.

The falls of the Rhine, about three miles below Schaffhausen, called the cataract of Lauffen, from an old chateau situated beside the cataract, form one of the most magnificent sights to be seen in Switzerland. The whole body of the Rhine discharges itself over a rock about 60 feet high, being divided into three falls by large masses of rock rising in the middle. The noise of the falling waters is tremendous, and the quantity of spray is very great, rising into the air like smoke. In some parts of the fall the green colour of the water has a fine effect; and, when we saw it in 1814, the purple tints of the western sky were finely reflected from the rising spray, while the fall itself was perfectly white. In an island immediately below the fall, there is a large dwelling-house, where an ingenious artist resides, who has a camera obscura for showing the falls. Close to the fall on the side opposite to Lauffen there is a snuff mill. The population of the town is about 6000. The canton extends over 170 square miles, and has a population of 32,000, the inhabitants being principally Calvinists.

SCHELDT, or Escaut. See Navigation, *Inland*, Vol. XV. p. 222, col. 2. and Netherlands, Vol. XV. p. 330.

SCHAMACHI. See Schirvan.

SCHEMNITZ, a large and populous town of Hungary. It is beautifully situated in a long valley, a few miles from the Raab. It contains several streets, with a number of good houses, but a great many of the buildings are irregularly distributed on both sides of the acclivity. It has two churches, two castles, two chapels, a royal mine office, where from 200 to 300 students, chiefly foreigners, are instructed in the principles and art of mining. The mines run below the town, which is nearly all undermined, and the extent of the mines is said to be about five or six miles square. The old water tunnel is 1100 feet below the surface, and the new ones much lower.

In our article Hungary, Vol. XI. p. 855, 856, we have already given a full and particular account of the mines of Schemnitz.

Including the suburb of Bela-banja, the population is about 23 000, of whom about 12,000 are engaged in the mines. East long. 18° 54′ 5″, North lat. 48° 47′ 45″.

SCHEUCHZER, John James, and John. See Botany, Vol. IV. p. 17, col. 2d.

SCHILLER, Friedrich Johann Christoph, was born at Marbach, a small town of Wurtemberg, on the banks of the Neckar, on the 18th Nov. 1759. His father, who had been a surgeon in the Bavarian army, and had served in the Netherlands during the succession war, obtained a captain's commission from the Duke of Wurtemberg, and he was principally employed in laying out the pleasure grounds at Ludwigsburg and Solitude.

Young Schiller received his earliest instructions from one Moser, pastor and schoolmaster in the village of Lorch, and he seems to have at this time taken up the idea of devoting himself to the clerical profession. He accordingly studied at Ludwigsburg in reference to this profession; and he underwent in four successive years the annual examination before the Stutgard commission, to which young aspirants to the church are subjected.

The Duke of Wurtemberg having provided a free seminary at Stutgard, pressed Schiller's father to avail himself of its advantages for his son. This offer embarrassed them exceedingly; but notwithstanding their previous determination, that young Schiller should be educated for the church, he was enrolled in the Stutgard school in 1773, for the purpose of following the profession of the law. The system of military drilling which prevailed in this school, and which gave formality to the amusements as well as to the studies of the pupils, accorded ill with the unconstrained freedom which Schiller had formerly enjoyed. Hence he was soon disgusted with his situation, and in 1775 he renounced for ever all views towards the profession of the law; but he passed only from the study of law to that of medicine, not as a more congenial pursuit, but as the means of detaching himself from one less attractive. He had begun to study in secret Plutarch, and Shakespeare, and Klopstock, Lessing, Herder, and Goethe. His admiration of the Messiah of Klopstock led him to compose, when he was only fourteen years old, an epic poem called "Moses." His attention was next directed to the drama, by the great popularity of the *Ugolino* of Gerstenberg, and the *Golz Von Berlichingen* of Goethe; and he composed a tragedy called *Cosmo Von Medicis*, some fragments of which he inserted in his *Robbers*.

When Schiller was in his 19th year he began his tragedy of the *Robbers*, the publication of which excited the greatest interest. Translations of it immediately appeared in almost all the languages of Europe, and were everywhere read with the mingled feelings of admiration and aversion. In Germany it was received with the most extraordinary enthusiasm; and though the general opinion was in its favour, yet the severest censures were passed on its moral tendency. He was accused of having injured the cause of morality, and of having excited the fiery temperaments of youth to pursue the fortunes of his abandoned hero. It has even been stated, that, under its pernicious influence, several students at Leipsig deserted their college, and resolved to form a troop of banditti in the Bohemian forest; but this and similar stories were entirely false, and had their origin in the circumstance of a German nobleman having been driven to the highway by a long course of debauchery and extravagance.

Nothing seems to have been more remote from Schiller's intention than to produce any such effects; and he even speaks in his preface of the moral influence of his piece in terms which, while they do honour to his heart, evince at the same time his inexperience and ignorance of the world. Schiller had finished the original sketch of the Robbers in 1778, but he had kept it secret till he had completed his medical studies. In 1778, he wrote a Latin essay on the *Philosophy of Physiology*, which was never printed; and after pursuing his studies with assiduity, he was, in 1780, appointed surgeon to the regiment *Augé* in the Wurtemberg army. This promotion enabled him to print the *Robbers* at his own expence, as no bookseller could be found to undertake it.

Although Schiller had, by the publication of this tragedy, forfeited the good opinion of the Grand Duke of Wurtemberg, yet its great popularity gained him many new friends and correspondents. Among these was Freiherr Von Dalberg, superintendant of the theatre of Manheim, under whose patronage Schiller remodelled the *Robbers*, and had it brought on the stage in 1781. Schiller went to Manheim in disguise, to see the first representation of his tragedy; but he was discovered, and put under arrest during a week for the offence. Having committed the same act a second time, he dreaded more rigorous measures, and he was therefore induced to quit Stutgard in October 1782. Afraid of residing so near to Stutgard or Manheim, he went to Franconia, and was living principally at Oggersheim under the name of Schmidt, when Madame Von Wollzogen, whose sons had been his fellow students at Stutgard, invited him to their country-house at Bauerbach, near Meinungen. Beneath her hospitable roof he resumed his poetical labours, and in the course of a year he brought out his tragedies of *Verschworung des Fiesco,* (*Conspiracy of Fiesco,*) and *Kabale und Liebe,* (*Court Intriguing and Love.*) During his arrest at Stutgard he had begun Fiesco, which was published along with another piece in 1783, and soon after brought out on the Manheim stage.

Schiller had long been ambitious of being appointed theatrical poet at Manheim; and his friend Dalberg was now able to assist him in procuring that appointment, which he obtained in Sept. 1783, and which, while it gave him a situation of respectability, held out to him the prospect of a seasonable remuneration. He was soon after elected a member of the German Society at Manheim, and acknowledged a subject of the Elector Palatine.

Schiller now engaged himself in bringing out a periodical work devoted to the concerns of the stage, the main purpose of which was to advance the dramatic art. The first number of this work, entitled the *Rheinische Thalia,* enriched with three acts of his *Don Carlos,* appeared in 1785, and with the exception of one short interruption was continued till 1794. This work, besides his dramatic speculations and performances, contains several of his poems.

About this period Schiller composed his *Philosophical Letters,* a short and unfinished fragment, which is interesting only as containing the speculations of its author on various metaphysical subjects, which must always possess a deep interest to every reflecting mind.

The first number of his Thalia had obtained Schiller such favour from the Duke of Sachsen Weimar, that this prince transmitted to him the title of a counsellor, and about the same time he received from Leipsig four miniature portraits, two of which were of very beautiful young ladies, who had admired his writings, and sent him this hidden mark of their esteem. This little incident is supposed to have induced him to remove to Leipsig, which he did in the end of March 1785. In this city, however, he did not long remain, and having received pressing invitations to Dresden, he followed the new impulse, and went to that capital at the end of summer. Here he took up his residence with the Apellationsrath Korner, who lived at Loschwitz, near Dresden; and he completed his *Don Carlos,* which was published in 1786. It is written in blank verse, and is the first of Schiller's plays that bears the marks of matured genius.

Schiller seems now to have taken a distaste at the drama, and to have occupied himself with the composition of various lyrical productions. Some of these have been mentioned by his biographer as among the most finished efforts of his genius, viz. the *Walk,* the *Song of the Bell,* his *Ritter Toggenburg,* his *Cranes of Ibycus,* and his *Hero and Leander.* Another poem, written about this time, and entitled *The Freethinking of Passion,* is said to have originated in a real but hopeless attachment to one of the first beauties of Dresden, who is said to have sat for the picture of the princess Eboli in *Don Carlos.* The celebrity of the thaumaturgic exploits of the conjuror Cagliostro at Paris, seems to have given rise to a novel which Schiller now produced, under the title of *Geisterseher,* or the *Ghost Seer,* two volumes of which were published.

The composition of this work seems to have given its author a dislike to fictitious writing, and he now resolved to devote his mind to the study of history. The composition of Don Carlos had led him to study the affairs of Spain under Philip II. and he was thus induced to take the *Revolt of the Netherlands* as the subject of his first history. While engaged in this work he projected a more extended one under the title of a *History of the most remarkable Conspiracies and Revolutions in the Middle and Later Ages,* of which he published the first volume in 1787, but it is little more than a translation of St. Real's *Conspiracy of Bedmar against Venice.*

Our author had long contemplated a visit to Weimar, which he at last effected in 1787. In this literary city resided Goethe, Herder and Wieland. With the two last he became extremely intimate; but Goethe, from his dislike of the *Robbers,* avoided an introduction to Schiller. In the midst of the best society in Germany, and occupied with his historical work, he continued his residence at Weimar. His old patroness Madame Von Wollzogen again invited him to Bauerbach; and at Rudolstadt, where he staid during a part of that visit, he first saw the Fraulein Lengefeld, a lady who made a deep impression on his heart, and who entertained for him a reciprocal feeling.

The first volume of his *History of the Revolt of the Netherlands* appeared in 1788, and while it added greatly to his reputation, it obtained for him the more solid advantage of a permanent settlement in life.

A vacancy having taken place in the professorship of history in the university of Jena, by the resignation of Professor Eichorn, Goethe (whose dislike to Schiller terminated in a warm friendship) recommended him to Amelia, the regent of Sachsen-Weimar, and along with Voigt, the head chaplain of the court, he solicited for him the vacant chair. This application having been seconded by the general voice, Schiller received the appointment and went to Jena in 1789. In the February following he married the Fraulein Lengefeld, and entered upon a new era in his life.

Thus occupied with the study of history as his profession, he devoted himself to the composition of a *History of the Thirty Years War,* which he published in 1791, and which is deemed in Germany his chef-d'œuvre in history. Soon after the appearance of this work Schiller was seized with a disorder in the chest, which, though its violence was overcome, never quitted him during the rest of his life. The duties of his class were discharged by proxy, and he was obliged to abandon all his historical studies. In this distressing condition a ray of benevolence shone upon him from an unexpected quarter. The hereditary prince, now reigning Duke of Holstein Augustenburg, conjunctly with the Count Von Schimmelman, conferred on him a pension of a thousand crowns for three years, under no other condition than that he should be careful of his health, and make every exertion for its recovery. The delicacy and politeness with which this act of generosity was profered, touched Schiller more than even the gift itself.

When the violence of his disease had abated, Schiller turned his thoughts into a new channel of speculation,—the study of the Kantian philosophy, a subject which had agitated all Germany. The views which he was led to take of this subject have been published in various treatises, the most elaborate of which are the essays on *Grace and Dignity,* on *Naivé and Sentimental Poetry;* the *Letters on the Æsthetic Culture of*

Schiller.

Man; on *Magic Art*; on the *Pathetic*; on the *Cause of our Delight in Tragic Objects*; on *Employing the Low and Common in Art*.

After conceiving and abandoning a design of writing an epic poem, of which Gustavus Adolphus was to be the subject, he again returned to the drama, and resolved to compose his *Wallenstein*. In 1793 he gave up his *Thalia*, and, with the assistance of Goethe, he began a new periodical work, under the title of *Horen*. He also undertook the superintendence of the *Musen-Almanach*, a kind of work very common in Germany, the object of which is to preserve and publish annually a series of short poetical effusions collected from various quarters. The *Musen-Almanach* was celebrated by a collection of epigrams called the *Xenien* or *Xenia*, a sort of *German Dunciad*, directed against the bad taste, dullness, and affectation, of a set of inferior authors who had viewed with a jealous eye the union of two such men as Goethe and Schiller. Although the *Xenia* were never completed, yet the part which did appear excited a great commotion among the dull malignants against whom they were directed. The *Musen-Almanach*, in which they appeared in 1797, was continued till Schiller left Jena, and the *Horen* ceased some months before.

The great work of *Wallenstein*, at which he had been busy for seven years, at last appeared in 1797, and is considered by competent judges to be the best performance that he had yet produced. It is regarded indeed by some as the greatest dramatic work of the eighteenth century. It has been translated into French by Benjamin Constant, and the last two parts of it into English by Mr. Coleridge.

After the publication of Wallenstein, Schiller removed to Weimar in quest of a milder winter climate; and on this occasion the pension which he enjoyed from the Duke of Weimar was increased, as it had been four years before when he received an invitation to the university of Tubingen. He shared along with Goethe the task of superintending the affairs of the stage. He remodelled, in conjunction with Goethe, his *Don Carlos*; and he now composed his *Mary Stewart*, a tragedy of much beauty, which appeared in 1800. In 1801 was published his *Maid of Orleans*, which is considered as one of the finest of modern dramas, and is supposed to evince more genius than any of the other productions of its author. It was highly popular on the stage, and added greatly to his reputation.

In 1803 he published his *Bride of Messina*, in which he has introduced the ancient chorus; but though it contains many fine pieces of lyrical poetry, yet it has found no imitator, and few admirers.

In the following year appeared his *Wilhelm Tell*, which is considered by his biographer as one of his very finest dramas, and "as exhibiting some of the highest triumphs which his genius, combined with his art, ever realised." "Less comprehensive and ambitious than *Wallenstein*, less ethereal than the *Maid of Orleans*, it has a look of nature and substantial truth which neither of its rivals can boast of."

In 1804, when Schiller was returning from Berlin, where he had been witnessing the exhibition of *Wilhelm Tell*, he experienced a violent attack of his former complaint; but he escaped its fury, and again resumed his labours. He executed various translations from the French and Italian, sketched a tragedy on the history of Perkin Warbeck, and finished two acts on Dimitri of Russia; but in the midst of these occupations he was again arrested by disease. The cold spring of 1805 brought back his complaint, and notwithstanding all the assistance which medical skill could give, he expired on the evening of the 9th of May, in the 46th year of his age, leaving behind him a widow, two sons and two daughters.

There were found among his papers his letters to Dalberg, which were published at Carlsruce in a small duodecimo in 1819. For the preceding facts respecting the life of Schiller, we have been indebted to *The Life of Frederick Schiller, comprehending an examination of his Works*, which appeared in London in 1825. It is an able and well-written piece of biography, which will be read with the deepest interest.

SCHIRAS, or SHIRAS, a celebrated city of Persia, and capital of the whole empire. It is finely situated between mountains in a rich plain, about seven leagues long and four broad, unrivalled for its beauty and fertility. The immediate environs of the city are laid out in magnificent gardens, the most celebrated of which is that of the Vakeel, now the garden of Jehan Nama. Through this fine foreground of trees and gardens the lofty domes of the mosques have a grand appearance, and excite expectations which are greatly disappointed upon entering the town. The streets are in general narrow, winding and dirty, and the houses are small and mean. The great bazaar or market place, built by Kurim Khan, is about a quarter of a mile long, built of yellow burnt brick, and arched at top, with numerous skylights to admit the light and the air. All the different trades of the city have quarters assigned to them in it. The citadel in which the governor resides, is a fortified square eighty yards wide, and is the residence of the governor. The royal palace is no ways elegant. Schiras carries on an extensive trade in sugar, pepper, cinnamon, chintz, piece-goods, which it receives from Bushire and India, and transmits them to Ispahan and Yezd, receiving in exchange the manufactures of these cities. The wine of Schiras has long been celebrated for its fine colour and rich taste.

Hafiz was buried in a small garden about one mile and a half from the city. His tomb, erected by Kurim Khan, is of black and white marble, in the shape of a coffin, having inscribed upon it two of his poems, and the date of his death, &c. A splendid copy of the works of Hafiz is always kept in an adjoining house. Population about 40,000. East long. 52° 44′, and north lat. 29° 36′. See Macdonald Kinneir's *Memoirs of the Persian Empire*.

SCHIRVAN, a province of the north of Persia, of the form of a triangle, the apex of which stretches into the Caspian Sea. Its breadth varies from 16 to 160 miles. This province has been divided into four districts, 1st, The plain at the foot of the mountains between the Rubas and the Ata; 2d, The strait ridge of mountains from the Atatschai to the plain on the left bank of the Kur; 3d, The plain on the river Kur; and 4th, The lofty mountainous district which limits the other three districts.

Schirvan is in general fertile, being watered by many rivers, some of which discharge themselves into the Caspian, and others into the Kur. The chief of these are the Samur, Deli, Sugaite, and Pirsagat. The villages in the plain between the Rubas and the Ata are surrounded with orchards, vineyards, and plantations of mulberries. The plain on the left bank of the Kur is, in a great measure, overgrown with rushes.

The principal towns of Schirvan are New Schamachi, the capital of Baku. Schamachi is situated in a plain on the river Aksisi. It is of a quadrangular form, each side being 800 paces long. The walls, which are built of unburnt brick, are surrounded with a deep ditch. Baku has already been described under that article. See Macdonald Kinneir's *Memoir of the Persian Empire.*

SCHLUSSELBURG, a town of Russia, situated on the left bank of the Neva, at its outlet from Lake Ladoga. It is defended by a fort about 146 yards square, built on an island in the Neva about 350 yards long. The walls, built of stone and brick, are about 50 feet high and very thick. Cotton and porcelain are manufactured here. Population about 3200.

SCHNEEBERG, a town of Saxony situated on an eminence near the Mulda. It contains several public schools. Smalts are manufactured here on a large scale. The chief products of the mines in the vicinity are iron, cobalt, bismuth, and silver. Population about 4500.

SCHRECKHORN. See Alps, Vol. I. p. 576—578.

SCHUMLA, or Ciumla, a town of Turkey in Europe, and in the province of Silistria, on the road from Constantinople to Wallachia. It has a castle and several handsome mosques. Hardware goods are manufactured here, and ready made clothes from Constantinople. The population is said to amount to 30,000. East long. 26° 56′, north lat. 43° 25′.

SCHWEITZ, the name of one of the Swiss cantons, situated adjacent to the lakes of Zug and Lucerne. It has a superficial extent of 460 square miles. The principal mountains are,

	Height in feet.
Mytten,	6000
Pregel,	5500
Regi,	6000

The chief occupation of the inhabitants is the pasturage of their cattle. The inhabitants who are Catholics amount to 30,000.

Schwerin.

Schweitz, the capital of the canton, is situated in a valley about two miles from the lake of Lowerz. The houses are good, and the church is large. Population 5000.

SCHWERIN, the capital of the grand duchy of Mecklenburg Schwerin, is pleasantly situated on the lake of Schwerin. The town, which is nearly square, is divided into the old and the new, the moor and the suburbs. The chateau or grand ducal palace, is situated on one of the charming islands of the lake. It is fortified, and communicates by a draw-bridge with the town. It contains a cabinet of natural history, a gallery of pictures, and fine gardens. The duke has also a fine chateau at Ludwigsburg, three miles from Schwerin, which is built in the modern style, with an English park. The principal public buildings and establishments in the city are the ci-devant cathedral church, two Lutheran churches, a Catholic church, an orphan's hospital, a poor's house, and a synagogue. There are here several breweries and distilleries, and a few trifling manufactures.

Not far from Schwerin and Wismar, are the sea baths of Dobberan, which are much frequented in July. Near these baths are the holy dike, a bulwark of great strength and antiquity, erected to keep off the sea. It is built of large stones with cement, polished and ornamented with figures analogous to those of the mythology of the northern nations. Population 8500. East Long. 11° 24′, North Lat. 53° 40′.

SCIENCE, CURIOSITIES IN.

Science, Curiosities in.

As it has been usual in works of this kind to collect under a general article what have been called *Rational Recreations*, or popular experiments, founded on some scientific principle, or tending to illustrate some scientific doctrine, we must, in obedience to the established usage, present such a collection to our readers.

We have made it our endeavour in all the scientific treatises in this work, to have them drawn up in as popular and intelligible a form as the subject would admit, without compromising the scientific character which all such articles must possess; and hence many popular instruments and showy experiments have been already fully described in this work. The subject, however, is far from being exhausted, and there still remains a vast number of scientific wonders and curiosities of which we have yet given no account. Many of them, however, are of such a hackneyed character, having appeared in so many works, and been so often the theme of popular lectures and exhibitions, that we shall direct the attention of our readers only to those which seem the most interesting, or which are distinguished by their brilliancy or their novelty, or by their importance as leading facts in the history of science.

Those who expect in this article a detail of tricks and deceptions which belong to the province of legerdemain, will be much disappointed. These have their interest, like every thing else, but they have no claim to a place in a Dictionary of *useful* knowledge.

For the sake of method, we shall follow the alphabetical arrangement of the sciences.

ACOUSTICS.

1. *On the Acoustic Figures produced by the Vibration of Plates.*

Galileo long ago pointed out a method of showing the vibration of plates held horizontally, by covering the plate with fine sand, which accumulated in those parts of the vibrating surface which were at rest. In the year 1787, M. Chladni of Wirtemberg made a great number of experiments on the nature of the vibrations produced by plates of glass of different shapes. In our article Acoustics, Vol. I. p. 121, we have done little more than mention these experiments, and have given a few specimens of the acoustic figures produced in these experiments in Plate II. Fig. 5, 6, 7, 8, 9; but as the subject is highly interesting, and as the experiments may be easily repeated, we shall make no apology for resuming the subject.

The plates used in such experiments should be thin plates of good window glass, from three to ten inches in diameter, having their edges ground to the shape required. The powder to be used may be very fine sand, but Professor Oersted, whom we have had the pleasure of seeing repeat many of Chladni's experiments, prefers the Lycopodium powder.

In order to damp the vibrations of the plates in particular places, we have only to pinch them between the finger and thumb of the left hand in the place directed, and then set them a vibrating by drawing a fiddle bow over their edge. Sometimes another place may be damped by the application of another finger of the left hand, or any points of the plates may be pressed against one or more fixed objects.

Plate CCCCLXXXIII. Fig. 1—3.

These methods of damping by the fingers, and by pressing against fixed obstacles, are shown in Plate CCCCLXXXIII. Fig. 1, 2, 3.

In Fig. 1. one part only is damped by being pinched between the fingers and thumb; but it is easy to damp another part by any of the three unoccupied fingers of the same hand.

In Fig. 2. the centre *c* of an elliptical plate is damped by pressing it with the thumb against a fixed point, such as a piece of cork, and two points at its circumference are damped by the application of two fingers.

In Fig. 3. the point *e* is damped by bringing the elliptical plate against an upright fixed obstacle *a b*, and the two points *c, d* are damped by the two fingers.

Fig. 4. In place of using the fingers alone, particular places may be damped by means of a wooden vice, Fig. 4. furnished with small wooden screws, or it would be easy to construct a more complicated one in which the arms moved round joints, so that a number of points could be easily pinched at the same time.

PLATE CCCCLXXXIII. Fig. 5. 1. If we take a square plate, Fig. 5. and pinch it in the centre, while it is put into vibration by drawing the bow near one of the angles, the sand will accumulate as in the figure, and the sound will be the gravest of all. Sometimes the figure changes into four curves, which join the middle of the sides of the plate.

Fig. 6. 2. If the square plate pinched at the centre is made to vibrate by drawing the bow along the middle of one of its sides, the sand will accumulate as in Fig. 6. and the sound will be less grave than in the preceding case.

Fig. 7. 3. If the plate Fig. 7. is pinched at N, and the bow applied at F in a line perpendicular to the side AB, the sand will arrange itself in three parallel lines.

Fig. 8. 4. But if it is pinched a little farther from the edge, as at N, Fig. 8. the lines will change into curves as in the figure.

Fig. 9. 5. If the square plate is held at N, and the bar applied at F, Fig. 9. two parallel lines, and one perpendicular line will be produced as in the figure.

Fig. 10. 6. If a *circular plate*, Fig. 10. is pinched at its centre, and also at another point of its circumference, and if the bow is applied 45° from this last point, a cross will be produced as in the square plate, Fig. 5. The tone is here the gravest that the plate can produce. Fig. 10. may be produced merely by pinching the plate at its centre.

Fig. 11. 7. Fig. 11. may be produced by the very same process as the last, merely by drawing the bow more gently and rapidly over the point of 45°. Sound less grave.

Fig. 12. 8. The effect in Fig. 12. where the rays form angles of 40° is produced by the very same process as that of Fig. 10, with this difference only, that the bow is drawn at a point 30° from the point in the circumference that is pinched. The figures which are formed of 2, 4, 6, 8, and 10 diameters, often assume deformed shapes, in which two of the lines unite to form a curve line, which does not pass through the centre of the plate. Thus the figure with eight rays, Fig. 13. sometimes assumes the form shown in Fig. 14. in which there is one nodal line left, the others being united in pairs into three curves. Fig. 13. Fig. 14.

When the centre of the circular plate is left free, a new set of figures are formed, as shown from Fig. 15. to 19.

Fig. 15. 9. Of these, one that gives the gravest sound, and the most simple form, is that of Fig. 15. formed of a single circular line. In order to produce this, any point through which the circular line is to pass is pinched, and the bow is drawn on the opposite side of the diameter passing through the point that is pinched; as this circular line has a determinate position, a few trials are necessary, to find the proper distance from the centre at which the plate is to be pinched.

Fig. 16. 10. To produce Fig. 16. composed of a diameter and a circular line, we must pinch the plate nearer its edge, and apply the bow to a point 90° from that point. The sound produced is more acute than the preceding.

Fig. 17. 11. Fig. 17. is produced by pinching the plate as in the last case, and applying the bow at a point 45° from the point pinched. In proportion as the diametral lines increase in number, the circular line approaches the margin of the plate.

12. Several circular nodal lines may be produced as in Fig. 18. To do this, we have only to pinch the plate in two or more places through which the lines are to pass; the two points that are pinched being always in the same radius, and their proper distance from the centre being found by trial.

13. The distortion of Fig. 18. shown in Fig. 19. is produced by pressing a point of the circumference against a fixed obstacle, and applying the bow at a point 30° from the point of contact, the interior circle being changed into an ellipse, and the outer one bent five times into itself.

14. When a circular plate of metal is pinched as in Fig. 3. against a fixed plate *e*, and pressed with the fingers at *c* and *d*, the figure in Fig. 20. is produced.

15. In an elliptical plate, of which the ratio of the diameters is as 4 to 3, and held as in Fig. 2. the sand is arranged as in Fig. 21.

16. With a triangular plate, Fig. 22. the form thus represented is produced by pinching the plate at *s* and applying the bow at *r*.

17. In the rhomboidal plate, Fig. 23. the form is produced also by pinching at *n* and applying the bow at *r*.

2. *On the Acoustic Figures produced by the vibration communicated through the air to elastic membranes.*

The very curious experiments on this subject made by M. Savart, have been recently (1822) read to the Academy of Sciences in Paris. The following abridged account of them is copied from Dr. Brewster's *Edinburgh Journal of Science*, vol. ii. p. 296.

In order to perform the experiments described by M. Savart, we must stretch a thin sheet of paper, about four or five inches in diameter, over the mouth of a vessel, such as a large glass with a foot-stalk, so that the paper has an uniform degree of tension, and a horizontal position. A thin layer of fine and dry sand or Lycopodium powder being then scattered over the paper, a plate of glass, in a state of vibration, is brought within a few inches of the membrane. The vibrations of the glass plate are conveyed through the air to the paper membrane, and the powder on its upper surface is thrown into figures which have sometimes the most perfect regularity, and are often formed with such celerity, that the eye has scarcely time to perceive the circumstances which accompany their formation.

This experiment succeeds in general, whatever be the vibrating body which we employ, though thin plates of glass or metal are the best; and it is always preferable to make the circular plate of glass vibrate in the mode in which there are concentric lines of repose. It appears from the experiments of Chladni, that, in order to obtain this kind of vibration, we must render immoveable several points in the surface of the plate, or at least two points of the circumference and one point of the surface. It is in this way, therefore, that M. Savart makes the experiment. He at first renders immoveable two diametrically opposite points of the circumference of the plate, by seizing it between the middle finger and the thumb. He then places lightly the tip of the index finger at a point, whose distance from the centre of the plate is about the fifth part of its circumference. The plate thus held is made to vibrate, by drawing the bow of a fiddle across its circumference. By employing successively circular plates of different dimensions, and which, consequently, give different sounds, it is easy to prove, that, for every number of vibrations, the membrane affects a particular mode of division. When the vibrating plate is parallel to the membrane, the latter performs normal vibrations, or vibrations in a line perpendicular to its surface. The sand sometimes springs to a great height; and, by making use of an apparatus which allows us to observe what passes at both surfaces of the membrane, it is easy to see that the distribution of the nodal lines is the same. The general character of these lines is to be circular, and their number is sometimes very considerable. These circular lines are often cut by diametral lines, which form stars, whose number of points increases with the acuteness of the sound. Sometimes figures are obtained which are composed solely of these diametral lines. Perfect regularity and symmetry, however, can only be obtained by taking the greatest care that the membrane be equally thick and uniformly stretched. The first of these conditions may be easily fulfilled by using the finest paper, particularly what is called vegetable paper, which is the most homogeneous that can be employed.

Some of the finest figures that are obtained by the effect of distant vibrations on the membrane are represented in Plate CCCCLXXXIII. Fig. 24—36. When the membrane is ill stretched, it often happens that the lines traced by the sand are very numerous, and that they form kinds of chains, regularly arranged, and apparently the result of concentric lines cut by a great number of diametral lines. See Fig. 37.

From these experiments it follows, that, when the plate and the membrane are parallel, the motion is communicated by the air exactly as it would have been if the two bodies had been separated by a common rod perpendicular to their faces; for the number of vibrations is the same in both cases; since, for each sound produced, the membrane affects a particular mode of division, and the direction of its motion is also the same, since it is perpendicular in the plate and in the membrane. If the vibrating circular plate is held with one of its diameters in a vertical line, the grains of sand have then a tangential motion, and the system of lines in repose have in general the character of parallelism. By gradually inclining the plate, the figures on the membrane change.

When figures composed of concentric circular lines are obtained, there is often formed between two of these a circular line, composed of the finer particles of the sand. M. Savart is of opinion that this line belongs to a kind of vibration higher than that which is produced, but which co-exists along with the principal vibration. It sometimes happens, also, that the centre of the membrane presents an immoveable point, which probably belongs likewise to a higher mode of vibration, so that the membranes appear to produce with facility several kinds of motion at once.

The preceding experiments may be varied in a great number of ways, by making use of membranes whose dimensions, nature, tension, and contour, are different; but they all present analogous results. The figures produced by a rectangular* membrane are shown in Plate CCCCLXXXIII. Fig. 38—45, and those produced by a triangular one in Fig. 45—51. When the diameter of the membranes is less than from half an inch to an inch, it is not easy to observe regular nodal lines, unless when the sound is extremely acute.

The figures which have now been described vary with the tension of the membrane. In those made of paper, which changes its hygrometric state, and consequently its tension, continually, M. Savart observed that the figures changed at every instant. When the same figure is represented several times, it was necessary only to breathe upon the paper to create a new one, which in a short time disappeared, and returned to its former state through a great number of intermediate figures. Hence M. Savart proposes this as a sure method of detecting small hygrometrical variations in the air. In order to protect the paper membranes from the humidity of the air, they should be covered with a thin coat of varnish made of gum lac.

The membranous vibrations and figures which have now been described may also be produced by the sound of the pipe of an organ, even at the distance of some feet. If we play with a slow motion an air on the flute, at about half a foot from the membrane, the sand will form lines, the figure of which varies unceasingly with the sound produced. But, what appears more astonishing, the voice produces an analogous effect, which is extremely well marked, even under the influence of a sound which is neither strong nor sustained. By whatever method, in short, the air is agitated, it is capable of communicating to thin membranes the motion which it has received, and that without any alteration.

These experiments succeed also equally well when the membranes are wetted, or when they have imbibed an oily substance. In this last case, in place of sand, we must cover the membrane with a thin stratum of oil, which is agitated in ripples, that increase in number with the acuteness of the sound.

M. Savart next applies these principles to a method of appreciating very small quantities of sound. He stretches a piece of thin vegetable paper or goldbeater's skin across the mouth of a glass about four inches in diameter. He then covers this with sand, and ascertains the intensity of different sounds by the distance at which they cease to agitate the membrane; and he remarks that the membrane will often be moved by an augmentation of sound which the ear itself is incapable of appreciating. He proposes also to use it for ascertaining the augmentations of sound which arise from the coincidence of vibrations produced by numbers of vibrations not very distant from each other.

Bodies which are neither rigid in themselves, and which are not rendered rigid by tension, such as the skin, a silken fabric, paper, &c. are, even when they are not stretched, susceptible of being thrown into vibrations by the influence of a body vibrating at a distance; and it appears that, under some circumstances, they are even more susceptible of this kind of action than most elastic membranes. This may be proved by covering a horizontal portion of any of these substances with sand, and sounding the pipe of an organ at the distance of a foot or so. The sand will be violently agitated, and will form figures composed of numerous curved and bending lines interlaced with one another.

In the second part of his able memoir, M. Savart applies these experiments to the illustration of the uses of the membrane of the tympanum, and of those of the external ear, both of which, as he shows by direct experiments on the ears of animals, are susceptible of being thrown into a state of vibration, by bodies vibrating at a distance. As our limits will not permit us to follow our author through his numerous and interesting details, we shall conclude this abstract with an enumeration of the leading results which he has obtained.

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* Almost all the figures given by square membranes are analogous to the figure of a square plate, and are almost always of the kind which Mr. Chladni calls *distortions*.

1. That it is not necessary to suppose, as has hitherto been done, the existence of a particular mechanism, for continually bringing the tympanum to vibrate in unison with the bodies which act upon it. It is evident, that the tympanum is always in a condition to be influenced by any number of vibrations.

2. That its tension does not probably vary, unless to augment or diminish the amplitude of its excursions, as Bichat had imagined. He supposed, however, contrary to the result of experiment, that the tympanum unstretched itself for strong impressions, and stretched itself to receive weak impressions.

3. That the vibrations of that membrane communicate themselves, without any alteration to the labyrinth, by means of the small bones, in the same manner as the vibrations of the upper table of an instrument are communicated to the lower table.

4. That the small bones modify also the excursions of the vibrating parts of the organs contained in the labyrinth.

5. That the cavity of the tympanum (*Caisse du Tambour*) serves probably to keep up near the apertures of the labyrinth, and the internal face of the membrane of the tympanum, an aërial medium, whose physical properties are constant.

3. *On Sounds Inaudible to Certain Ears.*

On sounds inaudible to certain ears.

In persons labouring under ordinary deafness, it seems to have been frequently noticed that they hear sharp sounds, such as the voices of women and children, better than the deep and grave tones of the male voice; and those accustomed to speak to deaf persons acquire a habit of addressing them in a shriller tone of voice, which is more efficacious than a louder tone.

Dr. Wollaston, however, has discovered that persons even whose ear is considered as perfect with regard to the generality of sounds, may be *completely deaf* to sounds at one or the other extremity of the scale of musical notes, the hearing or not hearing of which depends wholly on the pitch or frequency of vibration which constitutes the note, and not upon the loudness or intensity of the noise.

In order to illustrate this affection of the ear, Dr. Wollaston proposes the following experiment, the effect of which he considers as resembling the mechanical separation of larger and smaller bodies by a sieve.

"If, says he, I strike the table before me with the end of my finger, the whole board sounds with a deep full note. If I strike it with my nail, there is also at the same time a sharp sound produced by quicker vibrations of parts around the point of contact. When the ear is exhausted, it hears only the latter sound, without perceiving in any degree the deeper note of the whole table. In the same manner, in listening to the sound of a carriage, the deeper rumbling noise of the body is no longer heard by an exhausted ear; but the rattle of a chain or loose screw remains at least as audible as before exhaustion."

In order to exhaust the ear, the mouth and nose are shut, and by making a forcible attempt to take breath by the expansion of the chest, the pressure of the air is strongly felt on the membrane of the tympanum. This state of exhaustion of the ear may, as Dr. Wollaston remarks, be preserved for a certain time without the continued effort of inspiration, and without even stopping the breath, since, by sudden cessation of the effort, the internal passage to the ear becomes closed by the flexibility of the Eustachian tube, which acts as a valve, and prevents the return of the air into the tympanum. It is not easy at first to relax the effort of inspiration, with sufficient suddenness to close the Eustachian tube, and thus maintain the exhaustion; neither is it easy to refrain long together from swallowing the saliva, which instantly puts an end to the experiment.

Dr. Wollaston has given the following scale of sounds, which are scarcely audible by some ears:

Cry of the *Gryllus campestris.*
Piercing squeak of the bat.
Chirping of the house cricket.
Chirping of the house sparrow, or four octaves above F in the middle of the piano forte.

Dr. Wollaston is of opinion, that human hearing extends but a few notes above the cry of the *Gryllus campestris.* He has met with several persons, who never heard it nor the squeak of the bat; with some, who never heard the chirping of the house cricket; and with one gentleman, who never heard the chirping of the common house sparrow. This he considers as the lowest limit of acute hearing, and the cases in which it exists to be very rare. He regards the note of the bat as a full octave higher than this, and he believes that some insects may reach, as far as one octave more; and the range of human hearing he conceives to be comprised between the lowest notes of the organ, and the highest known cry of insects, including more than nine octaves, the whole of which are distinctly perceptible by most ears, although the vibrations of a note at the higher extreme are 600 or 700 fold more frequent than those which constitute the gravest audible sound.

Dr. Wollaston concludes his very important paper by the following curious conjecture. "Since there is nothing," says he, "in the constitution of the atmosphere, to prevent the existence of vibrations incomparably more frequent than any of which we are conscious, we may imagine that animals like the grylli, whose powers appear to commence nearly where ours terminate, may have the faculty of hearing still sharper sounds which at present we do not know to exist; and that there may be other insects hearing nothing in common with us, but endowed with a power of exciting, and a sense that perceives vibrations of the same nature indeed as those which constitute our ordinary sounds, but so remote, that the animals who perceive them may be said to possess another sense, agreeing with our own solely in the medium by which it is excited, and possibly wholly unaffected by those slower vibrations of which we are sensible." See *Phil. Trans.* 1820, part ii. p. 306—314.

4. *On the Increase in the Intensity of Sound during the Night.*

Every person must have observed, that sounds, such as that of falling water, &c. which are faintly or not at all heard during the day time, are distinctly audible at night, even when the direction and force of the wind, and every other general circumstance is the same. This curious fact was remarked even by the ancients. In large cities, or in their neighbourhood, this increase in the distinctness of sound has been ascribed to the cessation of the powers of animated beings, such as men, insects, and birds, and also to the cessation of the action of the wind upon the leaves of the trees. When the celebrated traveller, Baron Humboldt, first heard the noise of the great cataracts of the Orinoco, in the plain which surrounds the Mission of the Apures, his attention was particularly called to this curious fact; and he was of opinion that the noise was three times greater in the night than in the day. The usual explanation of the phenomenon was quite insufficient in the present case, as the humming of insects was much greater in the night than in the day, and the breeze, which might have agitated the leaves of the trees, never rose till after sunset. Humboldt, therefore, was led to ascribe the diminution of the sound during the day to the presence of the sun, which influences the propagation and intensity of sound, by opposing to them currents of air of different density, and partial undulations of the atmosphere, produced by unequal heating of the different parts of the ground. In these cases, a wave of sound, when it meets two portions of air of different density, is divided into two or more waves, a part of the primitive wave being propagated with more rapidity through the denser portions, than the parts that pass through air of less density. In this way the wave is broken down into different parts which arrive at the ear at different times. These different portions of the wave passing again through succeeding portions of the atmosphere of different density, may be so wasted and frittered down, as to be incapable of affecting the tympanum.

This curious phenomenon is precisely analogous to the production of the mirage, or phenomena of unequal refraction, which are occasioned by the mixture of portions of air of different refractive density.

5. *Explanation of the deception of the invisible Girl.*

In our articles Acoustics, Vol. I. p. 127, we have mentioned in a few words the principle of this very singular deception, which was some years ago exhibited in London and Edinburgh by M. Charles.

A perspective view of the apparatus by which this deception was performed, is shown in Plate CCCCLXXXIV. Fig. 1, a plan of it in Fig. 2, and a section of it in Fig. 3.

The apparatus shown in Fig. 1, was suspended in the middle of a room lined with wainscot, though this is not essential to the experiment. Four upright posts A, A, A, A, Fig. 1, are united at top by a cross rail BBB, and by two similar rails at bottom. This framework being placed on the floor, there proceeded from the top of each upright post A, four bent cross wires *a*, *a*, *a*, *a*, which met together at the top *c*, where they terminated in a summit of any kind. From these four wires a hollow copper ball M, about a foot in diameter, was suspended by four slender ribbons *b*, *b*, *b*, *b*; and round this ball were placed four trumpets T, T, T, T, having their mouths opening externally.

When the spectator entered the apartment, he was called upon by the exhibitor to propose some question, which he did by speaking into the mouth of one of the trumpets T. When this was done, an answer immediately issued from all the trumpets, sufficiently loud to be heard by an ear applied to any of them, and yet so weak that it seemed to come from a very diminutive person. The invisible lady conversed in several different languages, sung beautifully, and made the most lively and apposite observations on whatever was going on in the room.

The method by which this deception was carried on is shown in Fig. 3. One of the posts AA, and one half TB of the hand-rail connected with it is hollowed into a tube, one end of which appears on the inside of the railing exactly opposite to the mouth of the trumpet T, while the other end communicated with a tube *p p* going below the floor *f f*, and passing up the wall to a wide deal case *h k*, similar to an inverted funnel, and large enough to contain a lady with a piano forte. A small hole closed with glass, is left through the funnel and side wall of the room about *h*, through which the lady may observe what is going on among the auditors.

When a question is now asked at the mouth of one of the trumpets T, the sound passes through the tube TAA *p p h* into the funnel *h*K, and is therefore distinctly heard by the lady. The answer likewise passes from the funnel along the tube *k p p* AAT, and striking the mouth of the trumpet, it is reflected back from it to the ear of the auditor. The sound appears to issue also from every trumpet as the tubes communicates with each other.

6. *On Ventriloquism.*

On Ventriloquism.

In our article Acoustics, Vol. I. p. 128, we have given a short notice on the subject of ventriloquism; but as the explanation there given is imperfect, though correct so far as it goes, it is proper to return to the subject.

The art of ventriloquism is founded upon a diligent study of the modifications which sounds undergo, when emitted under a variety of different circumstances; and, without a perfect knowledge of this part of his art, the ventriloquist will display his powers with little success. A sentence uttered by the same lips, and with the same intonation, behind a door shut or half open, or by a person enclosed in a box, or secreted in the chimney, will obviously convey to those who hear it some idea of the locality of the person who utters it. If a ventriloquist, therefore, should have studied these modifications so completely, that he can pronounce the sentence with the precise modifications which the sound experiences, those who hear this sentence must believe that it is uttered by a person in the chimney for example. In order, however, that this belief may be complete, the ventriloquist must turn his back upon his auditors, or must possess also the power of speaking with the muscles of his throat, so as not to move his lips, or alter the features of his face; for if any muscular action were seen in the face of the performer, it will be a vain attempt to impose upon the auditors, however nicely the sound be imitated. The only conclusion would be, that the performer was an excellent imitator, but without any powers of deception.

But even if the ventriloquist has the power of speaking without moving the muscles of his throat or face, and has the most complete power of imitating sounds under all possible modifications, another condition is necessary to the success of his performances. A line drawn from the mouth of the ventriloquist to the ear of any of his auditors, must not be greatly inclined to the line drawn from the object from which he wishes the sound to appear to proceed to the ears of any of his auditors. If the ventriloquist, for example, were placed to the south of his auditors, it would be in vain for him to attempt to cause any sound to proceed from an object to the north of the auditors, or even from an object east or west of them. The dullest ear is capable of distinguishing the direction from which sounds actually proceed to a greater degree than this. There is, however, a certain angle within which the ear cannot distinguish differences in the direction of sounds. Thus if a sound issued exactly from the south point of the horizon, and the same sound from a point of the compass to the west of south, an ordinary ear could not determine which of the two sounds came from the south, and which from the west of south. The ventriloquist must therefore take care not to place the object, from which the sounds are to appear to come, without the range of this angle.

The angle within which we cannot judge of the direction of sounds, depends on the state of the ear, and varies with different individuals, and with the condition of the air, as well as with the nature of the sound.

7. *On the Polarisation of Sound.*

On the polarisation of sound.

We have already seen in our article on OPTICS, that when light passes through crystallized bodies, or is reflected at a particular angle from transparent surfaces, it receives a particular modification called polarisation, in virtue of which it passes more freely through transparent bodies, when presented to it in one way than when presented to it in another. Mr. Wheatstone of London, has discovered an analogous phenomenon with respect to sound, which he describes as follows:

"I connected a tuning fork with one extremity of a straight conducting rod, the other end of which communicated with a sounding board; on causing the tuning fork to sound, the vibrations were powerfully transmitted; but on gradually bending the rod the sound progressively decreased, and was scarcely perceptible when the angle was a right one. As the angle was made more acute, the phenomena were produced in an inverted order; the intensity gradually increased as it had before diminished, and when the two parts were nearly parallel, it became as powerful as it was when the rod was straight. By multiplying the right angles on a rod, the transmission of the vibration may be completely stopped.

In these experiments, the axes of the oscillations of the tuning fork should be perpendicular to the plane of the moveable angles; for if they be parallel the vibrations will still be transmitted. In order to prove this, Mr. Wheatstone placed a tuning fork perpendicularly on the side of a rectilineal rod. The vibrations were therefore communicated at right angles: When the axis of the oscillations of the forks coincided with the rod, the intensity of the vibrations was a maximum.

In proportion as the axis deviated from parallelism the intensity diminished, and when it became perpendicular the intensity was a minimum. The phenomena of polarisation may be observed in many corded instruments. The cords of a harp are attached to a conductor, which has the same direction as the sounding board. If any cord be altered from its quiescent position, so that its axis of oscillation shall be parallel with a bridge or conductor, its tone will be full; but if the oscillations be excited, so that their axis be at right angles to the conductor, the tone will be feeble. See the *Annals of Philosophy*, No. xxxii. p. 37.

8. *M. Ventau's Gigantic Meteorological Eolian Harp.*

M. Ventau's gigantic meteorological Eolian harp.

Captain Haas of Basle, has designated by these names an apparatus which emits of itself a variety of sounds during a change of weather. Since the year 1787, he had stretched above his garden fifteen iron wires, 320 feet long, and at the distance of about two inches from one another; the largest were two lines in diameter, the smallest one line, and those of intermediate size one and a half line. They were situated towards the south, and inclined 20° or 30° to the horizon, being stretched by means of rollers properly arranged for the purpose. Whenever the weather changes, these wires sound with such loudness, that it was impossible to go on with a concert in the house. The sounds sometimes resembled the hissing noise of water in rapid ebullition, sometimes that of a harmonicon, and sometimes that of a distant chime or an organ.

The inventor of this curious apparatus is M. Ventau, provost at Burkli, not far from Basle. He sometimes shot at a mark from his window; and in order that he might not go to the mark after each shot, he attached to it a long wire to draw it to him at pleasure. He remarked more than once, that the wire sounded exactly an octave; and he found that every iron wire, stretched in a direction parallel to the south, emitted this tone at every change of weather.

A brass wire did not produce any sound, nor did an iron wire, when it is stretched from east to west.

M. Dobereiner of Jena, conceives that the phenomenon now described is an effect of an electro-magnetic action; and he proposes to try if the brass wire would not sound when it communicates at its extremity with an energetic electrometer. See Dr. Brewster's *Journal of Science*, vol. iii.

9. *Description of the Harmonica.*

The name *harmonica* has been given to a combination of musical glasses, having their sizes so adjusted to one another, as to give the different octaves of the sounds which are commonly employed in music. When the glasses, however, have different thicknesses, though their size and their mode of vibrating be the same, they give sounds proportional to their thicknesses. It is necessary therefore to choose glasses whose thickness is equal throughout the whole of their surface. Glasses must also be chosen which have a clear and agreeable sound, and which can be easily put into vibration. Thin glasses with a high stalk have been commonly employed, or cups of glass or porcelain. When glasses with stalks are used, they must be placed vertically beside one another, and in the order of the notes of the different octaves. They are then tuned by pouring more or less water into them, which depresses the sound more and more. When the glass vibrates, the water is also thrown into a state of vibration, as may be seen by the ripples which are formed on its surface. Other fluids may be employed, but the quantity poured in will vary with their specific gravity. If mercury is put into a very large vessel, the edge of which is rubbed by the bow of a fiddle, the ripples on the surface of the mercury are very large, and are kept up for a much longer time. In place of using a bar, it is customary to apply the wetted finger. In this way the sound produced is the same as that which produces the figure shown in Plate CCCCLXXXIII. Fig. 10.

In the harmonica thus constructed, there is necessarily a perceptible interval between the production of the different sounds. In order to remedy this disadvantage, the cylindrical or rotatory harmonica has been constructed. It consists of seven glass cups of a proper size, having a horizontal axis passing through their centre, and to which is given an uniform and continuous rotatory motion. A belt or board of leather kept constantly wet, is extended over all the glasses in the direction of their length, its two extremities being firmly fixed, in order that the rotatory motion of the glasses may not drag the leather along with them. In order to bring out a note from any particular glass, we have only to press the leather upon the glass, and the intensity of the sound may be made to vary with the degree of pressure applied. Still, however, a perceptible interval of time elapses before the motion of vibration is communicated to each glass; so that this instrument is only suited to perform pieces of music, the movement of which is very slow.

M. Grenié has made great improvements on the harmonica. Having procured cups of glass of the same

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kind, and of dimensions suited to the musical scale which he wishes to embrace, he perforates them all at their summit or bottom, at the place where they are to be fixed on the cylinder. He then takes spherical moulds, and grinds down the glasses upon a turning lathe both on the inside and on the outside, till they are exactly of the same thickness. He next grinds them gradually down on their rim perpendicular to their axis, until when placed on the cylinder they give out the exact sound which is wanted, which is done by comparing the sounds with those of a well-tuned organ. The same process is applied to every one of the glasses; so that an instrument fitted up in this way is in every respect preferable to those made in the ordinary manner.

M. Biot, from whom we have taken the preceding description of the harmonicon, remarks that persons of a nervous temperament are deeply affected with the tones of this instrument.

10. *Description of the Melodion.*

This musical instrument was invented about twelve years ago by M. Dietz, a German, and he has given it the name of melodion from the sweetness and harmony by which it is characterized. We had the good fortune to hear the instrument in actual use at Geneva in 1814, a short time after its invention, and we are surprised that it has not come into more general use. This instrument was so complete that it imitated a whole band of music, and its tone had a sweetness and a force which we have never heard equalled. The only printed notice that we have seen of it is that given by Biot, which we shall follow. The melodion embraces five octaves, the different notes of which are produced by the vibrations of metallic rods* of the same material, but of unequal lengths, fixed at one end and free at the other. The vibratory motion was communicated to them by a metallic cylinder or wheel, which the performer turned by means of a pedal. The surface of the cylinder, however, is not applied directly against the rods. Each of the rods carries at its free extremity and at right angles to its direction, a narrow and thin plate of copper screwed to it, and having its surface covered with a small piece of felt impregnated with colophane. This small band being placed near the circumference of the revolving cylinder is made to descend by touching the key which belongs to it till it comes into contact with the revolving cylinder and gives out its sound. The sound continues as long as the plate of copper is pressed against the cylinder, and it may be increased or softened by increasing or diminishing the motion of rotation of the cylinder. The moment the finger is taken from the key the plate of copper quits the cylinder and rests upon a soft body which instantly makes its vibrations cease.

As the sounds of metallic rods are directly proportional to their thicknesses and reciprocally to their lengths, the rods must be lengthened and diminished in diameter in order to produce grave sounds. In this case it is difficult to elicit their fundamental sound, and when the flexibility of the rods is great the vibrations are uncertain. M. Dietz has in a very ingenious manner remedied these disadvantages. He loads the metallic rods with small metallic discs perforated in the direction of their diameter, so that they can be kept by friction on any part of the rod. By sliding these discs along the rod, the intonation of the rod varies with the position, and the sound becomes more grave in proportion as these discs increase in magnitude. This double effect enabled him to obtain very grave sounds with very stiff rods, and to regulate the tuning of the instrument with the greater facility.

AEROSTATION.

Aerostatics.

In our article on AERONAUTICS Vol. I. we have given a very full account of the history of aerial navigation, and of the method of constructing, filling, and using balloons, as well as the different pieces of apparatus connected with them. Since that article was printed, no essential improvements have been made upon balloons, although numerous aerial voyages have been performed in this country by the two Mr. Sadlers, Mr. Graham, and Mr. Green; of whom Mr. Sadler, jun. and Mr. Graham have fallen victims to their intrepidity.

Before the general introduction of gas illumination, it was both an expensive and a troublesome operation to fill balloons, even when they were of small size and intended only for amusing experiments. Now, however, that in almost every town coal gas is manufactured, the filling of balloons either for aeronautical ascents, or for the purposes of amusement, has become very easy. The gas obtained from coal is sufficiently light to make a balloon, filled with it, rise with a considerable ascensive power. The specific gravity of coal gas varies from one-third to two-thirds of that of atmospheric air; but the gas obtained from oil varies from two-thirds to nearly the same specific gravity as atmospheric air, so that it is entirely unfit for aerostatic purposes.

One of the simplest and most beautiful experiments in aerostation is to take a turkey's maw or stomach, properly prepared,† and to fill it either with pure hydrogen gas, or the carburetted hydrogen produced from coal. If it is allowed to escape in the open air it will ascend rapidly in the atmosphere; but the best method of showing the experiment is to let it off in a high staircase, and observe it ascend to the cupola, where it will remain near the highest point till the escape of the gas allows it to descend.

Small balloons.

Small balloons, either for rising with rarefied air, or with hydrogen gas, may be made by pasting together gores of lawn paper cut out as shown in Fig. 5. of Plate III. of AERONAUTICS. If they are intended for rarefied air, their lower ends must be pasted round a slender hoop, from which proceed several wires terminating in a kind of basket sufficiently strong to support a sponge dipped in strong spirits of wine. When the spirits are set on fire their combustion will produce a much greater degree of heat than any ordinary flame, and by thus rarefying the air within the balloon will enable it to rise with great rapidity and to a very considerable height.

If the balloon is to be filled with hydrogen gas, the paper should be well varnished; the lower end of the gores should terminate by being pasted round a small tube sufficient for admitting the gas, and capable of being completely closed after the gas is introduced. When the balloon is filled it will then rise with facility in the atmosphere.

The new varnish invented by Charles Mackintosh,

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* We understood that the melodion which we saw at Geneva consisted of a number of steel tubes of different lengths and bores.

† These are to be purchased in London for about four or five shillings each.

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Esq. Glasgow, and made by the dissolution of caoutchouc, or the naptha obtained from coal tar, is peculiarly fitted for rendering balloons strong and air tight.

ARITHMETIC.

Arithmetic.

As we do not mean to occupy our pages with the numerous arithmetical tricks which are now to be found in every popular work, we propose to confine our attention to the subject of magic squares and circles. The following treatise on this subject prepared for this work by an able correspondent, contains many new original views and constructions which cannot but prove interesting to the curious reader.

1. *Magic Squares.*

Magic squares.

Magic squares are of two kinds; the roots of the one being even numbers, of the other odd numbers.

The rules for their construction are peculiar to each kind, and we shall begin with giving those for odd numbers.

Magic Squares of odd numbers.

Magic squares of odd numbers.

The lowest square of this kind has 3 for its root, but as it is incapable of any variation in its arrangement, we shall elucidate the rules we give chiefly from the square of 5.

Plate CCCCLXXXIV. Fig. 4.

Having divided the square A, B, C, D, into 25 cells, fill them up with the numbers 1 to 25 in their natural order, as in Plate CCCCLXXXIV, Fig. 4.

In this square inscribe another square, E, F, G, H, and divide it likewise into 25 cells; 13 of which will now appear filled with numbers. The remaining 12, which are crossed by the subdivisions of the exterior square, being empty. To fill them up proceed as follows:

Transfer the numbers in the upper triangle E, A, F, viz. 1, 6, 2, to the three empty cells immediately below the centre (13), and in the same order. Transfer the numbers 24, 20, 25, in the lower triangle G, D, H, to the empty cells above the centre; the numbers 21, 16, 22, in the triangle C, E, G, on the left to the empty cells on the right of the centre, and the numbers 4, 10, 5, in the triangle F, H, B, on the right to the empty cells on the left of the centre.

The figures in the interior square being now made permanent with ink, and the pencil marks rubbed out, the magic square E, F, G, H, will remain. The amount of each column, horizontal or vertical, and also of each of the diagonals, being all the same or 65.

This is a very simple and easy method of making a magic square of odd numbers, and is applicable to every one of the kind, whatever may be its dimensions. It is said to be the invention of M. Bachet, and some of the rules commonly given to make these squares are evidently derived from it. It would appear that it was thought incapable of being varied in the arrangement; as no mention is made of this property in any treatise on the subject we have seen, we shall therefore show how this can be done with little trouble.

The natural arrangement of the numbers in the exterior square A, B, C, D, may be varied in two ways; 1st, In the vertical columns, any one of which may be shifted from its situation except the middle column, which contains the central number 13; 2d, In the horizontal columns, which may be shifted in the same way except the middle column, which contains the same number 13.

Fig. 1. natural.

4	2	3	1	5
9	7	8	6	10
14	12	13	11	15
19	17	18	16	20
24	22	23	21	25

In this way, no less than 576 different arrangements may be given to the square of 5. The square of 7 may be varied 518,400 different ways, and that of 9 upwards of twenty millions of ways.

Fig. 1. and 2. show the vertical columns altered, and the magical square derived from it. Fig. 3. and 4. show the horizontal columns altered, with its magical square.

Fig. 2 magical.

14	21	7	20	3
1	12	25	8	19
17	5	13	21	6
10	18	4	11	22
23	9	16	2	15

Fig. 3. natural.

6	7	8	9	10
21	22	23	24	25
11	12	13	14	15
1	2	3	4	5
16	17	18	19	20

Fig. 4. magical.

11	19	22	5	8
9	12	20	23	1
2	10	13	16	24
25	3	6	14	17
18	21	4	7	15

Fig. 5. and 6. show them both altered, and the magical square resulting from it. It is remarkable that all these variations can be made without shifting the central number of the square.

Fig. 5. natural.

9	7	8	6	10
24	22	23	21	25
14	12	13	11	15
4	2	3	1	5
19	17	18	16	20

Fig. 6. magical.

14	16	22	5	8
6	12	20	23	4
2	10	13	19	21
25	3	9	11	17
18	24	1	7	15

If a still greater variety is wanted, the following very ingenious method, invented by Poignard, and improved by De la Hire, will, we have no doubt, give ample satisfaction.

Poignard's Method.

Example in the Square of 5.

In the square A, B, C, D, Fig. 1. divided into 25 cells, place in the first horizontal column at top, the five first numbers of the natural progression in any order at pleasure, which we shall here suppose to be 1, 3, 5, 2, 4. Then make choice of a number which is prime to the root 5, and which, when diminished by unity, does not measure it. Let this number be 3, and for that reason begin with the third figure of the series, and count from it to fill up the second horizontal column 5, 2, 4, 1, 3. Then begin again with the next third figure, including the 5, that is to say by 4, which will give for the third column 4, 1, 3, 5, 2. By following the same process, we shall have the series of numbers 3, 5, 2, 4, 1, to fill up the fourth column, and 2, 4, 1,

1	3	5	2	4
5	2	4	1	3
4	1	3	5	2
3	5	2	4	1
2	4	1	3	5

3, 5, to fill up the fifth and last column. This square will be one of the component parts of the required square, and will be magic, for the sum of each column, whether horizontal, vertical or diagonal, is the same, as the five figures of the progression are contained in each without the same figure being repeated.

5	0	15	10	20
10	20	5	0	15
0	15	10	20	5
20	5	0	15	10
15	10	20	5	0

Now in another square of 25 cells, Fig. 2. inscribe in the first column, the root 5 and its multiples, beginning with a cypher, viz. 0, 5, 10, 15, 20, and in any order at pleasure, such for example, 5, 0, 15, 10, 20. Then fill up the square according to the same principles as before, taking care not to assume the same number in the series always to begin with. Thus for example, as in the former square, the third figure in the series was taken, in the present one the fourth must be assumed, and thus we shall have a square of multiples as seen in Fig. 2. This is the second component of the required magic square, and is itself magic, since the sum of each column is always the same.

6	3	20	12	24
15	22	9	1	18
4	16	13	25	7
23	10	2	19	11
17	14	21	8	5

Now to obtain the magic square required, nothing more is necessary but to inscribe in a third square of 25 cells, Fig. 3. the sum of the numbers found in the corresponding cells of the preceding two. For example 5 and 1, or 6, on the first of the left at the top of the required square, 0 and 3, or 3 in the second, and so on. By these means we shall have the square Fig. 3. which will necessarily be magic.

By this method any of the numbers may be made to fall on any of the cells at pleasure; for example, 1 on the central cell. We have only to fill up the middle band with the series of numbers in such a manner that 1 may be in the centre, as seen in Fig. 4. and then to fill up the rest of the square, according to the above principles, beginning at the highest column when the lowest has been filled up. To form the second square, place a cypher in the centre as seen in Fig. 5. and fill up the remaining cells in the same manner as before, taking care as in the former, not to assume the same quantities for beginning the columns.

Fig. 4.

2	1	3	4	5
3	4	5	2	1
5	2	1	3	4
1	3	4	5	2
4	5	2	1	3

Fig. 5.

20	5	10	0	15
0	15	20	5	10
5	10	0	15	20
15	20	5	10	0
10	0	15	20	5

In the last place, form a third square, by adding together the numbers in the similar cells, and you will have the annexed square Fig. 6. where 1 will necessarily occupy the centre.

Fig. 6.

22	6	13	4	20
3	19	25	7	11
10	12	1	18	24
16	23	9	15	2
14	5	17	21	8

Remarks.

1st, We must here observe, that when the number of the root is not prime, that is, if it be 9, 15, 21, &c. it is impossible to avoid a repetition of some of the numbers, at least in one of the diagonals; but in that case it must be arranged in such a manner, that the number repeated in that diagonal, shall be the middle one of the progression; for example 5, if the root of the square by 9; 8, if it be 15: and as the square formed by the multiples will be liable to the same accident, care must be taken in filling them up, that the opposite diagonal shall contain the mean multiple between 0 and the greatest; for example 36, if the root be 9, 105, if it be 15, &c.

2d, The same thing may be done also in squares which have a prime number for their root. By way of example, we shall form a magic square of the two first of the annexed ones, in the first of which, Fig. 7. the number 3 is repeated in the diagonal descending from right to left, and in the second, Fig. 8. 10 is repeated in the diagonal from left to right. This, however, does not prevent the third square, Fig. 9. formed by their addition from being magic.

Fig. 7.

1	2	5	4	3
2	5	4	3	1
5	4	3	1	2
4	3	1	2	5
3	1	2	5	4

Fig. 8.

10	0	5	15	20
20	10	0	5	15
15	20	10	0	5
5	15	20	10	0
0	5	15	20	10

Fig. 9.

11	2	10	19	23
22	15	4	8	16
20	24	13	1	7
9	18	21	12	5
3	6	17	25	14

Magic Squares of Odd Numbers with Borders.

Magic squares of odd numbers with borders.

There is an additional property which it has been found can be given to these squares, viz. that whatever may be the dimensions, any one or two or more of the exterior rows may be removed all round the square, and the remaining square still continue magic. They are constructed by the following rules:

Preliminary Remarks on the Natural Square.

Preliminary remarks on the natural square.

1. In the middle there is a cell, which we shall call the centre.

2. One half of all the other numbers in the square are less, and the other half greater than the centre. The former we shall call *Minors*, the latter *Majors*.

The cell in the centre is now to have a strong line drawn round it, the cells next to this are likewise to be bounded by a strong line, and so on with each surrounding row to the extremity of the square. These lines will appear as so many eccentric squares, and the spaces bounded by them containing the numbers we shall call *belts*.

3. The belt next the centre we shall call the 1st belt, and continue numbering them outwards 2d, 3d, 4th belt, &c.

4. Those belts having the odd numbers we shall call the *odd belts*, those having the even numbers we shall call the *even belts*.

5. Supposing now that the square is divided diagonally into four parts, we shall distinguish them by the names of the *upper*, the *lower*, the *left*, and the *right quarters*; and we may here observe, that the minors occupy all the upper quarters, the left quarter from the top to the cells opposite the centre inclusive, and the right quarter from the top to the cells opposite the centre exclusive.

Preparation of the Natural Square.

6. Mark all the corner cells on the left of the upper quarter . . . . *a*
The corner cells on the right of do. . . . *b*
The middle cells of the upper quarter . . *m*
The cells on the left quarter opposite the centre *c*
In the even belts alone,
Mark a cell in each, in the upper quarter, next the corner cells, on the left *s*
on the right *r*
Mark the cells in the left quarter immediately under *a*, *n*
And the cells on the right quarter immediately above those which are opposite the centre, *d*

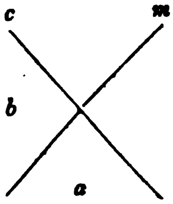
Rules for transferring the Minors *from the Natural to the Magic Square.*

Rules for transferring the minors from the natural to the magic circle.

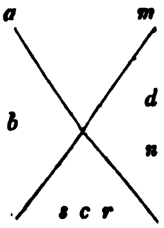
7. General rules. These numbers, when carried from any belt in the natural square, must be placed in a similar belt in the magic square.

8. They must never be placed opposite, either diagonally, or facing each other.

9. Particular rules. For the odd belts.
In the left corner cells of the upper quarter, place *c*
In the right corner cells of do. place . . *m*
In any cells out of the corners in the lower quarter place *a*
In any cells out of do. in the left quarter . *b*



10. For the even belts.
In the left corner cells of the upper quarter, place *a*
In the right corner cells of do. . . . . *m*
In any cells on the left quarter between the diagonals, place . . . . *b*
In any cells on the right quarter do. and not facing *b*, place . . . . *d* and *n*



In any cells in the lower quarter, between the diagonals place *s*, *c*, and *r*. The minors, which are lettered, being thus inserted in the magic square, the remainder must be transferred by the following general rules:

11. In the upper quarter, the cells remaining unmarked, are either in number 4 or its multiples, as 8, 12, 16, in each belt. Of the numbers in these then, place the extremes in the upper, and the means in the lower quarter of the magic square, in their appropriate belts. Thus, suppose there are four unlettered in any belt, the numbers in which are 2, 3, 5, and 6, place No. 2 and 6 in the upper, and 3 and 5 in the lower quarter and similar belt of the magic square. Or the extremes may be carried to the lower, and the means to the upper quarter, no matter which.

12. In the right and left quarters, the cells unmarked in each belt are always in pairs, as 2, 4, 6, 8, &c. Carry the numbers in one half, say the upper half of those on the left quarter to the left quarter of the magic square, and the lower half to the right quarter. Do the same with those which are unlettered on the right quarter, but in the reverse order; so that the amount of the numbers so transferred shall be the same in each of these quarters.

13. The minors being all transposed, will each of them, if properly placed, have a corresponding empty cell in its own belt, either diagonally opposite, if it is in a corner, or facing it, if in any cell between the diagonals.

14. These empty cells are now to be filled with the *majors*, which is done without any reference to the natural square. Each minor must have its proper major, which is that number which the minor wants of the amount of the first and last number of the progression. Thus, if the series runs from 1 to 25, the amount of these is 26; and if the minor in question be 7, its major of course must be 19, &c. Inserting the majors, therefore, diagonally opposite those numbers which are in the corner cells, and facing those which are situated between the diagonals, each in the same belt with its minor, the magic square will be completed.

Example in the Square of 11.

NATURAL SQUARE.

a 1	2	3	4	Odd. 5	*m* 6	*s* 7	8	9	10	*r* 11
12	*a* 13	*s* 14	15	Even 16	*m* 17	4 18	19	*r* 20	*b* 21	22
23	*n* 24	*a* 25	26	Odd. 27	*m* 28	3 29	30	*b* 31	32	33
34	35	36	*a* 37	*s* Even 38	*m* 39	2 *r* 40	*b* 41	42	43	44
45	46	47	*n* 48	*a* Odd. 49	*m* 50	1 *b* 51	*d* 52	53	*d* 54	55
c 56	*c* 57	*c* 58	*c* 59	*c* 60	61	62	63	64	65	66
67	68	69	70	71	72	73	74	75	76	77
78	79	80	81	82	83	84	85	86	87	88
89	90	91	92	93	94	95	96	97	98	99
100	101	102	103	104	105	106	107	108	109	110
111	112	113	114	115	116	117	118	119	120	121

MAGIC SQUARE.

56	2	121	3	Odd. 118	117	115	114	9	10	*m* 6
12	*s* 13	15	106	Even 108	65	102	19	104	*m* 17	110
23	35	*c* 58	97	Odd. 26	95	93	30	*m* 28	87	99
88	98	36	*a* 37	Even 84	63	82	*m* 39	86	*n* 24	34
11	76	*b* 31	70	*c* Odd 60	73	*m* 50	*d* 52	91	46	111
77	68	75	*b* 41	*b* 51	61	71	81	47	*d* 54	45
100	79	80	74	72	*a* 49	62	*n* 48	42	42	22
89	54	53	83	*s* 38	*c* 59	*r* 40	85	69	68	33
44	*b* 21	94	*a* 25	96	27	29	92	64	101	78
55	105	107	16	*s* 14	*c* 57	*r* 20	103	18	109	67
116	120	*a* 1	119	4	5	7	8	113	112	66

Magic Squares of Even Numbers.

These are generally subdivided into two kinds,—

1st, Oddly even squares, which are those whose roots when halved produce odd numbers, as the squares of 6, 10, 14, 18, &c.

2d, Evenly even squares, are the squares of 4 and its multiples, as 8, 12, 16, &c.

The first kind, though possessing fewer properties, is more difficult of construction than the second. We have seen no method superior to the following one, which embraces both kinds, and at the same time the additional property of being bordered, so that the exterior surrounding row or rows may be removed, and the square remaining still continue magic.

This method is similar to the one immediately preceding for squares of odd numbers, and the description and rules there given will enable us to shorten what follows for even numbers.

Preparation of the Natural Square.

1. The first strong line is to be drawn round the central square of 4, and the circumscribing lines are to be continued from that to the extremity of the square. The belts are then to be numbered 1, 2, 3, &c. and named odd and even belts as in the odd squares.

2. The numbers above the middle horizontal line are the minors, those below it are the majors, and the square is supposed to be divided into four quarters by the diagonals.

3. The square of 4 in the middle is excluded from the following directions, and is to be filled up in the magic square after the other numbers are inserted, by a rule to be given afterwards.

4. In the odd belts,

Mark all the corner cells on the left of the upper quarter . . . . *a*
The corner cells on the right of do. . . . . *b*
The cells in the upper quarter on the left *c*
next the corner, . . . on the right *d*
The cells in do. next *c* and *d*, on the left *m*
on the right *n*
The cells in the lowest range of on the left *p*
minors, . . . on the right *s*
The cells on the left immediately under *a*, . *o*
The cells on the right immediately above *s*, *r*

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5. In the even belts,

Mark the corner cells in the upper quarter, on the left *f*
. . . on the right *g*
The cells next *f* and *g* in do. on the left *h*
on the right *i*
The cells in the lowest range of on the left *t*
minors, ... on the right *v*

Rules for transferring the Minors from the Natural to the Magic Square.

Rules for transferring the Minors from the natural to the magic square.

6. The general rules, 7 and 8 for odd squares are to be followed here.

7. Particular rules for the odd belts.

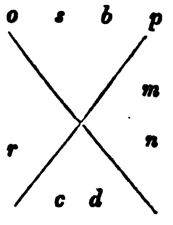
In the corners of the upper on the left place *o*
quarter, . . on the right *p*
In any cells between *o* and *p* place . . *s* and *b*
In any cells in the lower quarter between the corners, and not facing *s* or *h*, place *c* and *d*
In any cells on the left quarter between the diagonals place . . . *a* and *r*
In any cells on the right quarter, between the diagonals, and not facing *a* or *r*, place *m* and *n*

8. For the even belts.

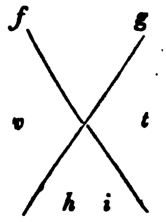
In the corners of the upper on the left place *f*
quarter . . . on the right *g*
In any cells in the lower quarter, between the diagonals, place . . . *h* and *i*
In any cells on the left quarter, between the diagonals, place . . . *v*
In any cells on the left quarter between do. not facing *v*, place . . *t*

They will then appear in the following order:

Odd Belts.



Even Belts.



The lettered numbers being now transferred, the remainder of the minors must be placed, and the majors added exactly in the same way as ordered for the odd squares, in the general rules 11, 12, 13, and 14.

The square of 4 in the middle of the natural square, being now made magic, by the rules given in the next section, and inserted in the middle of the magic square, the whole will be completed.

Example in the Square of 12.

NATURAL SQUARE.

f 1	*h* 2	3	4	5	Even 6	4 7	8	9	10	*i* 11	*g* 12
13	*a* 14	*c* 15	*m* 16	17	Odd. 18	3 19	20	*n* 21	*d* 22	*b* 23	24
25	*o* 26	*f* 27	*h* 28	29	Even 30	2 31	32	*i* 33	*g* 34	35	36
37	38	39	*a* 40	*c* 41	*m* Odd 42	1 *n* 43	*d* 44	*b* 45	46	47	48
49	50	51	*o* 52	53	54	55	56	*r* 57	58	*r* 59	60
t 61	*p* 62	*t* 63	*p* 64	65	66	67	68	*s* 69	*v* 70	*s* 71	*v* 72
73	74	75	76	77	78	79	80	81	82	83	84
85	86	87	88	89	90	91	92	93	94	95	96
97	98	99	100	101	102	103	104	105	106	107	108
109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132
133	134	135	136	137	138	139	140	141	142	143	144

MAGIC SQUARE.

f 1	3	143	4	140	Ev 9	en. 134	10	139	138
13	*o* 26	*s* 71	130	17	Od 20	d. 127	*b* 23	123	126
25	38	*f* 27	29	117	Ev 32	en. 115	112	114	*g* 34
84	*a* 14	39	*o* 52	*s* 69	Od 104	d. 101	*b* 45	*p* 64	105
108	129	94	*a* 40	53	91	90	56	105	51
v 72	95	82	103	80	66	67	77	*m* 42	*t* 63
96	124	*o* 70	*r* 57	68	78	79	65	88	75
121	*r* 59	99	102	89	55	54	92	*n* 43	46
109	110	58	81	6	*c* 41	*d* 44	100	93	87
48	47	111	116	*h* 28	113	30	*i* 33	31	118
60	83	74	*c* 15	128	125	18	122	*d* 22	19
133	142	*h* 2	141	5	136	*i* 11	135	6	7

These squares are capable of being greatly varied, as it is not necessary to insert the numbers in the natural square in a regular order, from the first to the last of the series, but we may commence with any number.

Of Magic Squares of 4, *and its Multiples.*

Of magic squares of 4, and its multiples.

The lowest root from which a magic square of even numbers can be constructed, is that of 4. This is readily done as follows:

In the square annexed A, divided into 16 cells, insert the numbers 1 to 16 in their natural order.

A

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

In a similar square B, insert the numbers in the diagonal cells as they stand in the diagonals of the natural square A; then beginning at the right hand corner at the bottom, (wherein No. 16. in A is,) insert the numbers 1 to 16 regularly in the reverse order, leaving out a number where the cell is already filled up. The square B will now be magic, the amount of the vertical, horizontal, and diagonal columns being each of the same, or 34.

B

1	15	14	4
12	6	7	9
8	10	11	5
13	3	2	16

This method is simple, and may be made use of to produce a great variety of these squares; for the order of the numbers in the natural square may be altered in a great many ways; as for instance in Fig. C annexed, which is made magic in this way, as in Fig. D.

C

5	7	6	8
1	3	2	4
13	15	14	16
9	11	10	12

D

5	10	11	8
16	3	2	13
4	15	14	1
9	6	7	12

Instead of beginning at the bottom, and inserting the numbers in the reverse order, after the diagonal cells are filled up, it will be found readier in these small squares to proceed thus:

Reverse the order of numbers 14 and 15 at the bottom of A, and place them at the top of B. Do the same with 2 and 3 at the top of A, and place them at the bottom of B. Reverse numbers 5 and 9 on the left of A, and place them on the right of B, as also 8 and 12 on the right of A, and place them on the left of B.

In the same way the squares of 8, 12, 16, &c. may be made magic.

Example in the square of 8.

Instead of giving here the square of 8 alone, we shall give it as it stands in the interior of 10, by which we can illustrate both this method, and the preceding rules for squares odd by even.

In a square of 100 cells, insert the numbers 1 to 100 in their natural order, draw strong lines round the interior square of 8, and divide it into four smaller squares, as shown in Fig. E. In another square of 64 cells, insert the diagonals as they are found in each of the small squares in the interior squares of E, as shown in Fig. F. Beginning, then, at the bottom of the right, where 89 is placed, insert the numbers as they stand in the interior square of E, in a reverse order, proceeding up-

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wards to the top of the square, and leaving out a number where the cell is already filled up, as ordered for the square of 4.

The square will now be magic, and is to be placed in the interior of another square G of 100 cells. The exterior row of cells in Fig. E is now to be lettered, and the numbers transferred to Fig. G, by the rules already given for squares oddly even. The magic square of 10 will thus be completed, as shown below.

Natural Square of 10.

E

a 1	*c* 2	*m* 3	4	5	6	7	*n* 8	*d* 9	*b* 10
o 11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	37	29	*r* 40
p 41	42	43	44	45	46	47	48	49	*s* 50
51	52	53	54	55	56	57	68	59	60
61	62	63	64	65	66	67	78	69	70
71	72	73	74	75	76	77	88	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

F

12			15	16			19
	23	24			27	28	
	33	34			37	38	
42			45	46			49
52			55	56			59
	63	64			67	68	
	73	74			77	78	
82			85	86			89

Magic square of 10.

Magic Square of 10.

G

o 11	*s* 50	4	99	96	92	7	95	*b* 10	*p* 41
a 1	12	88	87	15	16	84	83	19	100
21	79	23	24	76	75	27	28	72	80
98	69	33	34	66	65	37	38	62	*m* 3
70	42	58	57	45	46	54	53	49	31
r 40	52	48	17	55	56	14	43	59	61
93	39	63	64	36	35	67	68	22	*n* 8
81	29	73	74	26	25	77	78	22	20
30	82	18	17	85	86	14	13	89	71
60	51	97	*c* 2	5	*d* 9	94	6	91	90

This naturally leads us to another property which may be given to these squares.

Magic Squares in Compartments.

Example in the square of 8.

Take the first 8 numbers and the last 8, and arrange them in a square of 16 cells; do the same with the numbers 9 to 16, and 49 to 56 for the second square; then 17 to 24, and 41 to 48, for the third square. Lastly, 25 to 40 for the fourth square, as seen in the Figures annexed.

Make each of these magical by the rules given for the square of 4, then putting them together in a square of 64 cells, they will appear as below, and possess of course not only the common properties of these squares, but also that of being composed of four similar magic squares.

Natural Squares in the Square of 8.

1st.				2d.				3d.				4th.			
1	2	3	4	9	10	11	12	17	18	9	20	25	26	27	28
5	6	7	8	13	14	15	16	21	22	23	24	29	30	31	32
57	58	59	60	49	50	51	52	41	42	43	45	33	34	35	36
61	62	63	64	53	54	55	56	45	46	47	48	37	38	39	40

Magic square of 8.

Magic Square of 8.

1	63	62	4	9	55	54	12
60	6	7	57	52	14	15	49
8	58	59	5	16	50	51	13
61	3	2	64	53	11	10	56
17	47	46	20	25	39	38	28
44	22	23	41	36	30	31	33
24	42	43	21	32	34	35	29
45	19	18	48	37	27	26	40

We have now given methods of constructing magic squares, possessing all the properties they were thought capable of containing previous to the appearance of Dr. Franklin's square of 16, which was published, we believe, for the first time in Ferguson's *Tables and Tracts*, under the title of the Magic Square of Squares.*

The principal property of this square was, that the amount of each half diagonal ascending, added to its adjacent diagonal descending, taken from any of the four sides, and likewise all the parallels to their half diagonals, was the same as that of the vertical or horizontal columns.

This was effected by an arrangement of the numbers, by which a property unknown or unnoticed before was given to these squares, viz. the equality of the sum of each small square or cluster of four cells, taken

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* In the second edition of Hutton's *Montucla*, there is a magic square of 16 by Mr. Dalby, professor in the Royal Military College, given as an improvement of Dr. Franklin's square. By means of two varieties of a particular arrangement, he has so far succeeded as to get the diagonals of the large square, and of each of its four squares of 8, equal to their other columns; but in gaining this property he has lost an essential one of Franklin's square, viz, the equality of the sums of every square of four adjacent cells through the whole square. The fault lies not in the *arrangement*, but in the *distribution* of the numbers. It is a curious circumstance, that the *arrangement* he has made use of is of that class which is necessary for forming Franklin's magic circles; and the professor was probably not aware of the property inherent in the square of forming a magnificent circle of this sort.

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any where throughout the whole square, that sum being in all cases double the amount of the first and last numbers of the progression.

In accomplishing this, Dr. Franklin gave up the property which these squares were generally made to possess, that of the two entire diagonals being each the same sum as the other columns. As by a different management this property may be retained, we shall not enter particularly into his method, but proceed directly to show how magic squares may be constructed, possessing all the properties of Dr. Franklin's square, conjoined with most of those which were formerly known.

As we shall frequently have occasion to mention the square of 4, we shall give to squares of that size the name of *petty* squares, and, as was observed in a preceding section, we shall call the first half of the numbers in a natural square minors, and the other half majors.

In the petty square B, page 568, the minors are disposed as annexed. Adding them vertically, each column amounts to 9. Adding them horizontally, the amount is 5, 13, 13, 5, two similar numbers being the sum of the extreme, and two others the sum of the middle columns. The majors, it will be seen, are so placed, that the sum of each, and its adjacent minor, is alternately 16 and 18 in the horizontal columns.

1			4
	6	7	
8			5
	3	2	

The position of the minors in the petty squares, of which the magic square of 8 is composed, is similar. The minors in the first square are the same as those in B, mentioned above. Those in the other squares, although composed of higher numbers, are arranged in the same order. Thus the minors in the third square are as in H annexed, where it may be observed, that the numbers as they ascend from 17 to 24 occupy cells similarly situated as the numbers ascending from 1 to 8 in the square B.

H

17			20
	22	23	
24			21
	19	18	

This disposition of the lower numbers in the petty squares, which may be varied in a great number of ways, we shall in future distinguish under the general appellation of the *Arrangement of the Minors.*

By the arrangement of the minors in the preceding squares, they possess the property of the sum of the diagonals being each equal to the sum of the vertical or horizontal columns, but they are deficient of that property possessed by Dr. Franklin's square, of the sums of any four contiguous cells being the same through the square, and no possible alteration of the position of the majors can give them this property. The arrangement of the minors must be altered.

One of the numerous arrangements suitable for this purpose is shown in I annexed, where it is observed, that the sums of the horizontal columns are alternately 5, 13, 5, 13, instead of 5, 13, 13, 5, as in the preceding squares.

I

1		4	
	6		7
	3		2
8		5	

Adding now the majors, so as to make the sum of each, with its adjoining minor in the horizontal column, equal to 16 and 18 alternately, the property wanted will be found, as in K annexed.

K

1	15	4	14
12	6	9	7
13	3	16	2
8	10	5	11

Arranging the minors of the square of 8, in the above order, they will stand as in the square L, and adding the majors so as to make the amount of each with its minor in the horizontal line, alternately 64 and 66, the square will be completed as seen in M.

L

1		4		9		12	
	6		7		14		15
	3		2		11		10
8		5		16		13	
17		20		25		28	
	22		23		30		31
	19		18		27		26
24		21		32		29	

M

1	63	4	62	9	55	12	54
60	6	57	7	52	14	49	15
61	3	64	2	53	11	56	10
8	58	5	59	16	50	13	51
17	47	20	46	25	39	28	38
44	22	41	23	36	30	33	37
45	19	48	18	37	27	40	26
24	42	21	43	32	34	29	35

In this square, it may be observed, that each of its petty squares is possessed of the desired properties; but the centre square is not, as at the junction of the petty squares some of the clusters of 4 cells contain numbers, whose amount is not exactly 130, as it ought to be. Thus the numbers in the four cells in the centre, are 59, 46, 25, and 16, amounting to 146. Here they exceed the proper sum, in other places they fall below it.

This defect cannot be remedied, by altering the *arrangement* of the minors in the petty squares. It is to be effected, by distributing the minors methodically through the whole square. Thus in square M, the minors 1 to 8 are placed in the first square, 9 to 16 in the second, and so on.

This disposition, it is evident, will not do. Numbers 1 to 8 must therefore be separated, and thrown into different petty squares. The minors in the other petty squares must likewise be separated and otherwise disposed of.

To distinguish this thorough arrangement from the preceding one, we shall give it the title of the *Distribution of the Minors.*

A considerable number of distributions may be found suitable for these squares—of 8, of 12, and of 16.

In these Tables, the first horizontal column is divided into as many parts as there are petty squares in that square to which each Table refers.

Under each of these divisions are two vertical columns, containing eight numbers, which are to be placed in each of the petty squares, and arranged in eight cells, in the same order as the numbers 1 to 8 are in some one of the varieties of arrangements which follow the Tables.

Distribution of the minors for the square of 12.

Distribution of the Minors for the Square of 12.

No. 1. for arrangements A and B.

1		2		3		4		5		6		7		8		9	
1	2	3	4	5	6	13	14	15	16	17	18	25	26	27	28	29	30
12	11	10	9	8	7	24	23	22	21	20	19	36	35	34	33	32	31
61	62	63	64	65	66	49	50	51	52	53	54	37	38	39	40	41	42
72	71	70	69	68	67	60	59	58	57	56	55	48	47	46	45	44	43

No. 2. for arrangements A and B.

1		2		3		4		5		6		7		8		9	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
24	23	22	21	20	19	30	29	28	27	26	25	36	35	34	33	32	31
49	50	51	52	53	54	43	44	45	46	47	48	37	38	39	40	41	42
72	71	70	69	68	67	66	65	64	63	62	61	60	59	58	57	56	55

Science, Curiosities in.

No. 3. for arrangements A and B.

1		2		3		4		5		6		7		8		9	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
31	32	33	34	35	36	25	26	27	28	29	30	19	20	21	22	23	24
42	41	40	39	38	37	48	47	46	45	44	43	54	53	52	51	50	49
72	71	70	69	68	67	66	65	64	63	62	61	60	59	58	57	56	55

Distribution of the Minors for the Square of 16.

No. 1. for Arrangements A and C.

	2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
39	38	37	36	35	34	33	48	47	46	45	44	43	42	41	56	55	54	53	52	51	50	49	64	63	62	61	60	59	58	57
66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96
03	102	101	100	99	98	97	112	111	110	109	108	107	106	105	120	119	118	117	116	115	114	113	128	127	126	125	124	123	122	121

No. 2. for Arrangements B and C.

	2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
4	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
0	91	92	93	94	95	96	81	82	83	84	85	86	87	88	73	74	75	76	77	78	79	80	65	66	67	68	69	70	71	72
2	123	124	125	126	127	128	113	114	115	116	117	118	119	120	105	106	107	108	109	110	111	112	97	98	99	100	101	102	103	104

No. 3. for Arrangement C.

1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
25	26	27	28	29	30	31	32	17	18	19	20	21	22	23	24	57	58	59	60	61	62	63	64	49	50	51	52	53	54	55	56
97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
121	122	123	124	125	126	127	128	113	114	115	116	117	118	119	120	89	90	91	92	91	94	95	96	81	82	83	84	85	86	87	88

Distribution of the Minors for the Square of 8.

No. 1. for Arrangements B and C.

1		2		3		4	
1	2	3	4	5	6	7	8
9	10	11	12	13	14	15	16
21	22	23	24	17	18	19	20
29	30	31	32	25	26	27	28

No. 2. for Arrangements A and C.

1		2		3		4	
1	2	3	4	5	6	7	8
13	14	15	16	9	10	11	12
17	18	19	20	21	22	23	24
29	30	31	32	25	26	27	28

No. 3. for Arrangements A and C.

1		2		3		4	
1	2	3	4	5	6	7	8
12	11	10	9	16	15	14	13
17	18	19	20	21	22	23	24
28	27	26	25	32	31	30	29

Various Arrangements for the Minors in the Petty Squares.

A

1

1	15	4	14
12	6	9	7
13	3	16	2
8	10	5	11

2

1		4	
8		5	
	3		2
6		7	

3

	1		4
	8		5
3		2	
6		7	

4

2		3	
	5		8
	4		1
7		6	

5

2		3	
7		6	
	4		1
	5		8

6

	2		3
5		8	
4		1	
	7		6

7

2	13	3	16
11	8	10	5
14	1	15	4
7	12	6	9

8

	2		3
	7		6
1		4	
8		5	

B

9

1	15	6	12
8	10	3	13
11	5	16	2
14	4	9	7

10

1		6	
	4		7
	5		2
8		3	

11

	1		6
	8		3
5		2	
4		7	

12

2		5	
7		4	
	6		1
	3		8

13

2		5	
	3		8
	6		1
7		4	

14

	2		5
	7		4
6		1	
3		8	

15

12	1	15	6
7	14	4	9
2	11	5	16
13	8	10	3

16

	2		5
	7		4
1		6	
8		3	

C

17

8	10	15	1
11	5	4	14
2	16	9	7
13	3	6	12

18

	5	4	
8			1
	3	6	
2			7

19

	3	6	
8			1
	5	4	
2			7

20

6			3
	1	8	
4			5
	7	2	

21

	1	8	
6			3
	7	2	
4			5

22

	7	2	
6			3
	1	8	
4			5

23

15	10	8	1
4	5	11	14
9	16	2	7
6	3	13	12

24

		6	3
2	7		
		4	5
8	1		

The preceding varieties of arrangements for the petty squares are in three rows, each row containing a different kind of them. Some of the distributions will be found not suitable for the varieties in all the three rows, being calculated only for those in one or two of these rows.

The first six varieties in each row are to have their majors added, as shown in Nos. 1, 9, and 17. The two last of each row must have the majors placed, as shown in Nos. 7, 15, and 23.

We annex examples of magic squares constructed from the preceding Tables, and as they possess all the properties of Dr. Franklin's square of squares, joined to most of those which were previously known, we have given them the name of Union Magic Squares.

The squares of 8 are constructed,
No. 1. from distribution No. 1. arrangement No. 10.
2 . . . . . . 2 8
3 . . . . . . 3 18
Of 12 are constructed,
No. 1 . . . . No. 10
2 . . . . . 2 4
Of 16 is constructed, No. 3 . . . . No. 20

Properties of these Squares. Square of 16.

Properties of these squares. Square of 16.

1. The amount of each column vertical or horizontal, is . . . . } 2056
2. Each half column vertical or horizontal, is 1028
3. Half a diagonal ascending, added to half a diagonal descending, taken from any of the four sides, is the same with all the parallels to these diagonals, ... } 2056
4. The amount of the 4 corner numbers in the large square, and also in any square of 12, 8, or 4, taken throughout the square, is, } 514
5. The sum of the numbers of any square or cluster of 4 cells taken throughout the square, is . . . . } 514

(These are all the principal properties of Dr. Franklin's square.)

Additional Properties of the Square of 16.

Additional properties of the square of 16.

6. The amount of each of the two diagonals is 2056
7. The square is composed of 16 squares of 4, each of which is a complete magic square, the amount of their vertical and horizontal columns, and of each diagonal, is . . } 514
8. The square of 8 may be taken 9 times, and the square 12 four times in the large square, each being a complete magic square.
9. The amount of the diagonals M *a*, *a* O, ascending and descending on each side of the vertical division NB, is 1028

The same with all their parallels to the top of the square.

The same with the diagonals and their parallels on each side of the other vertical divisions OC and PD.

The same with all the diagonals and their parallels, reckoning from any of the other sides, making in all 156 equal sums.

10. If the square is cut into four columns, through the vertical divisions BN, CO, and DP, the parts may be exchanged at pleasure, and all the properties remain the same.
11. If it is in like manner cut into four, through the horizontal divisions FG, HI, and KL, these may likewise be exchanged, and the properties remain unaltered. By having the option of these mutual interchanges, the square may be arranged in 576 different ways, without having occasion to alter a single figure in the petty squares.

The squares of 12 and of 8 possess similar properties as far as their dimensions go. The numbers in the columns of the square of 12 amount to 870. The sums of their diagonals on each vertical or horizontal division, ascending and descending, amount to 580. The number of these equal sums with their parallels is 72. By cutting it through the two vertical or horizontal divisions, it may be arranged in 36 different ways, without altering its properties.

The square of 8 may be arranged in four different ways as in Plate CCCCLXXXIV.

2. *Magic Circles.*

The only magic circle that has hitherto appeared is that of Dr. Franklin, which was published fifty years ago by Mr. Ferguson in his *Tables and Tracts*.

The arrangement of the minors in the petty squares, is totally different from any of those given in the preceding pages, we therefore subjoin a few varieties of it.

62	73	14	25	30	41	46	57
24	15	72	63	56	47	40	31
71	64	23	16	39	32	55	48
17	22	65	70	49	54	33	38
69	66	21	18	37	34	53	50
19	20	67	68	51	52	35	36
60	75	12	27	28	43	44	59
26	13	74	61	58	45	42	29

This circle contains 64 numbers, proceeding regularly from 12 to 75, and, as may readily be supposed, is constructed from a magic square of 8, a copy of which is annexed, the numbers being placed in the same order as they are found in the circle. The sum of the first and last number is 87. Four times this is 348, which is the amount of each column. This added to 12, a number placed in the centre of the circle, makes 360.

A

1

13	12	5	4
3	6	11	14
10	15	2	7
8	1	16	9

2

		6	3
7	2		
		1	8
4	5		

3

		5	4
8	1		
		2	7
3	6		

4

		1	8
7	2		
		6	3
4	5		

5

		6	3
4	5		
		1	8
7	2		

6

		2	7
3	6		
		5	4
8	1		

1

			7	2
B	1	8		
			4	5
	6	3		

2

		8	1
5	4		
		3	6
2	7		

3

		3	6
5	4		
		8	1
2	7		

4

		8	1
2	7		
		3	6
5	4		

5

		4	5
6	3		
		7	2
1	8		

6

		4	5
1	8		
		7	2
6	3		

No. 1. (A) is filled up with the majors in the same way that the others must be done. The sum of the two extremes, as also that of the two means in the horizontal column, is to be made equal to the sum of the first and last number of the progression. Thus, in the square of 4 it will be 17, in the square of 8 it will be 65, in that of 12 it will be 145, &c. when the series begins with unity.

The preceding square of 8 is constructed from four varieties of the same kind of arrangement as these, although any one of them would have done quite as well for the magic circle. In the square, the sum of each vertical is equal to that of each horizontal column, as likewise their halves, but the diagonals do not agree with them.

By making use of two of the above varieties, and of the distribution No. 1. in page 571, a square of 8 may be formed, having its diagonals the same sum as the other columns, and which will give to the circle an additional property. Any two of the varieties will do, provided one of them be taken from the row A, and the other from the row B.

67	54	33	20	65	52	35	22
10	13	74	47	42	15	72	45
46	75	12	41	44	73	14	43
21	32	55	66	23	34	53	64
71	50	37	16	69	48	39	18
17	36	51	70	19	38	49	68
58	63	24	29	56	61	26	31
28	25	62	59	30	17	60	57

The annexed square is composed of arrangements No. 2. A, and No. 4. B, the first being used in the upper half, and the second in the lower half of the square. The numbers commence at 12, and end at 75, as in Dr. Franklin's, and from the square they are transferred to the circles No. 1, and 2, the two circles being necessary to avoid confusion in the figure, and to render the explanation of its properties intelligible.

Construction of the Circles.

The diameter of the exterior circle is divided into 19 equal parts. The diameter of the interior circle embraces three of these parts, and the remaining divisions mark the diameters of the other seven circles. The circumference of the large circle is divided into eight equal parts, and radii drawn to these divisions, as shown in the figures. There are thus 64 cells formed between the interior and exterior circles for the numbers of the square, which are placed so as to appear as radii at equal distances between the linear ones.

Properties of the Magic Circle.

1. The sum of the numbers in each of the concentric circles added to the central number 12, is 360
2. The numbers in each radius added to 12 is 360
3. The numbers in half the circles, taken above or below the horizontal line AB, added to C= 180
4. The numbers in half the radius added to C= 180
5. Any four adjoining numbers forming a square added to C= 180
6. If from O, Plate CCCCLXXXIV. Fig. 7. as a centre, circles be described through the points of intersection at *a*, *b*, *c*, *d*, *e*, and *f*, in the radius *of*, the numbers in the spaces between each pair of these circles added to 12= 360.
7. The numbers in the half of each of these eccentric circles above and below the horizontal line, added to 6= 180

If circles, in like manner, be described from the centres *p*, *q*, and *r*, the numbers between each pair, as also their halves, will amount to the same sums.

These are the principal properties of Franklin's circles.

Additional Property shown in Fig. 8.

Fig. 8.

8. If from the interior circle eight spirals be described at equal distances from each other, and in the same direction, so that each makes one complete revolution in its passage to the exterior circle, as in Fig. 7, the spaces between each pair of these spirals will contain 8 numbers, whose amount added to 12= 360

If the spirals are made to revolve in a contrary direction, the amount of the numbers in the similar spaces will still be the same.

ASTRONOMY.

Description of an Astrometer.

Description of an astrometer.

This name was given by M. Jeurat to a simple instrument for finding the rising and setting of the stars and planets, and their position, which he has described in the Memoirs of the Academy of Sciences.

The following is an improved instrument of the same kind, and which is capable of solving many other astronomical problems.

Plate CCCCLXXXV. Fig. 1.

This instrument represented in Plate CCCCLXXXV. Fig. 1. consists of four divided circumferences. The innermost of these is moveable round the centre A, and is divided into twenty-four hours, which are again subdivided into quarters and minutes, when the circle is sufficiently large. The second circumference is composed of four quadrants of declination, divided by means of a table of semidiurnal arcs, adapted to the latitude of the place. In order to divide these quadrants, move the horary circle, so that 12 o'clock noon may be exactly opposite to the index B: then since the star is the equator, and its declination 0, when the semidiurnal arc is VI hours, the zero of the scales of declination will be opposite VI. VI. and as the declination of a star is equal to the colatitude of the place, when its semidiurnal arc is 0, or when it just comes to the south point of the horizon, without rising above it, the degree of declination at the other extremity of the quadrant, or opposite XII. XII. will be the same as the colatitude of the place, which in the present case is 39°, the latitude of the place being supposed 51° North. The intermediate degrees of declination are then to be laid down from a table of semidiurnal arcs, by placing the degree of declination opposite to the arc to which it corresponds, thus the 10th degree of south declination must stand opposite V^{h} 13′ in the afternoon, and VI^{h} 47′ in the morning, because a declination of ten degrees south gives a semidiurnal arc of V^{h} 13′. When the scales of declination are thus completed, the instrument is ready for showing the rising and setting of the stars. For this purpose move the horary circle till the index B points to the time of the star's southing; then opposite to the star's declination in the scale C, if the declination is south, or in the scale D if it is north, will be found the time of its rising above the horizon; and the degree of declination on the scales E and F, according as it is south or north, will point out on the horary circle the time of the star's setting. If the rising of the star is known from observation, bring its declination to the time of its rising on the circle of hours, and the index B will point out the time at which it passed the meridian; and its declination on the opposite scale will indicate the time when it descends below the horizon. In the same way, from the time of the star's setting, we may determine the time when it rises and comes to the meridian.

The two exterior circles are added to the astrometer, for the purpose of finding the position of the stars and planets in the heavens. The outermost of these is divided into 360 equal parts, and the other, which is a scale of amplitudes, is so formed, that the amplitude of any of the heavenly bodies may be exactly opposite the corresponding degree of declination in the adjacent circle. The degrees of south declination, for instance, in the latitude of 51°, corresponds with an amplitude of 15½°, consequently the fifteen degrees of amplitude must be nearly opposite to the tenth degree of declination; so that by a table of amplitudes, the other points of the scale may be easily determined. The astrometer is also furnished with a moveable index M N, which carries at its extremities two vertical sights *m n*, in a strait line with the centre A. The instrument being thus completed, let it be required to find the planet Saturn, when his declination is 15° north, and the time of his southing $3^h\ 30'$ in the morning. The times of his rising and setting will be found to be $7^h\ 15'$, and $10^h\ 45'$, and his amplitude 24° north. Then shift the moveable index till the side of it which points to the centre is exactly above the 24th degree of the exterior circle in the north-east quadrant, and when the line A B is placed in the meridian, the two sight holes will be directed to the point of the horizon where Saturn will be seen at $7^h\ 15'$, the time of his rising. The same being done in the north-west quadrant, the point of the horizon where the planet sets will likewise be determined. In the same way the position of the fixed stars, and the other planets, may be easily discovered.

If it is required to find the name of any particular star that is observed in the heavens, place the astrometer due north and south, and when the star is near the horizon, either at its rising or setting, shift the moveable index till the two sights point to the star. The side of the index will then point out, on the exterior circle, the star's amplitude. With this amplitude enter the third scale from the centre, and find the declination of the star in the second circle. Shift the moveable horary circle till the time at which the observation is made be opposite the star's declination, and the index B will point to the time at which it passes the meridian. The difference between the time of the star's southing, and 12 o'clock noon, converted into degrees of the equator, and added to the right ascension of the sun if the star comes to the meridian after the sun, but substracted from it if the star souths before the sun, will give the right ascension of the star. With the right ascensions and declination thus found enter a table of the right ascensions and declination of the principal fixed stars, and you will discover the name of the star which corresponds with these numbers.—The meridian altitudes of the heavenly bodies may always be found by counting the number of degrees between their declination and the index B. The astrometer may be employed in the solution of various other problems; but the application of it to other purposes is left to the ingenuity of the young astronomer.

CHEMISTRY.

The science of chemistry presents such a mass of curious and amusing experiments, that it would be a hopeless task to attempt even to enumerate them in a short article like the present. Most of them too have been so often exhibited in lectures, and so frequently described in popular collections, that the repetition of them here would be unprofitable. We shall, therefore, confine ourselves to the description of some of the most curious and most recently discovered experiments and instruments, which could not well be introduced into any other part of the work.

1. *On the Revival of the Inscriptions on Coins and Medals by Unequal Oxidation.*

It has been long known, though we have not been able to ascertain to whom we owe the discovery, that a coin, from which the inscription and the figures have been entirely effaced, so as not to present the slightest trace of an impression, may have the inscription and figure partly or wholly restored, by placing it upon a hot iron. In order to perform this experiment with the fullest effect, the coin employed should be one equally worn down, and in which very little of the metal has been rubbed off the hollow parts by which the letters are surrounded.

When a coin of this kind, or what is still better, a coin on which an illegible trace of the letter still remains, is placed upon a heated iron, it will be seen that an oxidation takes place over its whole surface, the film of oxide changing its tint with the intensity or continuance of the heat. The parts, however, where the letters of the inscription had existed, oxidate at a different rate from the surrounding parts, so that these letters exhibit their shape, and become legible in consequence of the film of oxide which covers them having a different thickness, and therefore reflecting a different tint from that of the parts adjacent. The tints thus developed sometimes pass through many orders of brilliant colours, particularly *pink* and *green*, and settle in a bronze, and sometimes a black tint, resting upon the inscription alone. In some cases the tint left on the trace of the letters is so very faint that it can just be seen, and may be entirely removed by a slight friction of the finger.

When the experiment is often repeated with the same coin, and the oxidations successively removed after each experiment, the film of oxide continues to diminish, and at last ceases to make its appearance. It recovers the property, however, in the course of time. When the coin is first placed upon the heated iron, and consequently, when the oxidation is the greatest, a considerable smoke rises from the coin, and diminishes like the film of oxide by frequent repetition. A coin which had ceased to give out this smoke, smoked slightly after twelve hours exposure to the air, having been removed from the hot iron at the beginning of that interval, and replaced upon it at the end of it by a pair of pincers.

From a great number of experiments I have found that it is always the *raised* parts of the coin, and in modern coins the elevated ledge round the inscription that oxidate first. This ledge, in an English shilling of 1816, began by exhibiting a brilliant yellow tint before it appeared on any other part of the coin.

In examining a number of old coins, a brilliant red globule, accompanied with a smell of sulphur, appeared on one or two points of the coin; and sometimes small globules, like those of quicksilver, exuded from the surface. Other coins exhaled a most intolerable smell; and an Indian pagoda became perfectly black when placed upon the heated iron.

Such being the general facts respecting the oxidation of coins, it becomes an interesting inquiry to determine its cause. If we take a homogeneous and uniform piece of silver, and place it upon a heated iron, its surface will oxidate equally, if all the parts of it are exposed to the same degree of heat. A coin, however, differs from a piece of silver of uniform texture, as it has been struck with great force during the act of coining. In this process the sunk parts have obviously been most compressed by the prominent parts of the die, and the elevated parts least compressed, the metal being left as it were in its natural condition. A coin, therefore, is a piece of metal in which the raised letters and figures have less density than the other parts, and consequently these parts oxidate sooner, or at a lower temperature. When the letters themselves are rubbed off by use, the parts immediately below them have also less density than the metal which surrounds them, and consequently they receive from heat an oxidation and a colour different from that of the surrounding surface. Hence, the reason is obvious, why the invisible letters are revived by oxidation.

A similar effect takes place in the beautiful oxidations which are produced on a surface of polished steel. When the steel has hard portions, called *pins* by the workmen, the uniform tint of the oxide stops near these points, which always display colours different from the rest of the mass.

The smoking of the coin, the diminution of its oxidating power, by a repetition of the experiment, and the recovery of that power by time, seem to indicate that the softer parts of the metal absorb something from the atmosphere which promotes oxidation.

2. *On the method of reading the inscriptions on coins and medals in the dark.*

Among the numerous experiments of a striking and popular nature, with which science astonishes, and sometimes even strikes terror into the ignorant, there is perhaps none more calculated to produce this effect than the one which forms the subject of the present article, while it possesses at the same time the higher advantage of presenting to us some scientific facts, which we believe have not hitherto been observed.

It has long been known that *black* surfaces radiate heat, or throw it off more copiously than *white* surfaces; and that the same difference takes place between *rough* and *polished* surfaces; those which are rough producing the same effect as those which are black; but in so far as we learn, no experiment has been made to prove, that the same results take place with *radiant light*; that is, that when bodies are heated to such a degree as to *radiate light*, those which have *black* or *rough* surfaces *discharge the light* more copiously than those which are *white* or *polished*.

This result respecting radiant light might no doubt have been inferred from the experiments on the radiation of heat, if these two substances had been previously found to comport themselves in a similar manner when thrown off by bodies, or reflected from their surfaces. But this has never been established; and therefore such an inference would have been premature in the present state of our knowledge. If we confide in experiments already made, indeed, we should be disposed to conclude, that light and heat do not follow the same laws, at least in their reflexion from bodies. Brass, for example, is said by Mr. Leslie to have a reflective power for *heat* of 100°, while silver has only a reflective power of 90°; but we know for certain, that silver reflects light much more copiously than brass. Notwithstanding this apparent discrepancy, we would rather question the accuracy of the experiment, than the truth of a law which has been long considered as general.

During the experiments on the revival of the inscription on coins by unequal oxidation, we had occasion to expose to a high degree of heat a coin, on which the inscription had been rendered black by oxidation. Upon taking the coin, while in a state of bright red heat, into a dark room, we were surprised to observe that the letters of the inscription were more luminous than the rest of the coin, in consequence of their oxidated surface radiating the red light more copiously than the other parts. Though the effect was not in this case sufficiently striking to enable me to read the inscription, yet it occurred to me, that if by the action of an acid, or any mechanical means, the general surface of the coin should be made rough, or have its polish removed, while the raised points which constituted the inscription and the figure were polished, an effect opposite to that in the preceding experiment should be produced. I accordingly took a French shilling of Louis XV. and having roughened the depressed parts of the surface, and heightened the polish of the inscription, &c. I placed it upon a red hot mass of iron, and removed it into a dark room. When the shilling began to radiate light, the inscription, BENEDICTUM SIT NOMEN DEI, appeared in obscure letters, while the ground on which they stood shone with a brilliant light. By polishing the depressed parts of the surface, and roughening the letters, I obtained, as might have been expected, the opposite effect, the inscription being now legible, from its throwing off more light than the surrounding surface.

In order to perform this experiment with most success, it is desirable to conceal from the observer's eye the mass of red hot iron on which the coin is placed, both for the purpose of rendering the eye fitter for observing the effect, and of removing all doubt that the inscription is really red in the dark; that is, without the light of any other body either direct or reflected falling upon it.

The most striking form in which this experiment can be exhibited, is to use a coin from which the inscription has either been wholly obliterated, or obliterated in such a degree as to be no longer legible. When such a coin is laid upon the red hot iron, the letters and figure become oxidated, as formerly described; and the black or brown film of oxide which is found upon them radiating more powerfully than the rest of the coin, the letters will shine more brilliantly than the other parts, and may be read to the great surprise of the observer, who had examined the blank surface of the coin before it had been placed upon the iron. His surprise will not be diminished, when he observes that the letters which he saw more luminous than the rest are now covered with a black film of oxide.

As the different radiating powers of parts of the same surface, can neither be seen by the eye nor indicated by any instrument, when the general temperature is below that of red heat, the principle of the preceding experiment may be employed to determine the relative powers of radiation possessed by different metals. Although the radiating powers, for example, of *gold*, *silver*, *copper*, and *tin plate*, are, according to the experiments of Mr. Leslie, *exactly* the same, yet we are persuaded that the preceding method will afford ocular demonstration of the incorrectness of this result, when these bodies are submitted to the experiment under the same circumstances of magnitude, thickness, and polish, in so far as this can be done. This opinion is founded on very unequivocal experiments on the reflective powers of these metals for light, which in general have a fixed relation to their radiating powers.*

3. *Production of sweetness by the mixture of two bitter substances.*

Production of sweetness by the mixture of two bitter substances.

The nitrate of silver and the hyposulphite of soda are two disgustingly bitter liquids. When a solution of the former in the state of a pure crystallised oxynitrate is added to a dilute solution of the latter, the most *intense* sweetness is produced. Mr. J. F. W. Herschel, to whom we owe this curious experiment, remarks that the issue of it shows how little we know of the way in which bodies affect the organs of taste. Sweetness and bitterness, like acidity, seem to depend on no particular principle, but to be regulated by the state of combination in which the same principles exist at different times.

4. *Light produced by breaking glass balls filled with oxygen.*

Light produced by breaking glass balls filled with oxygen.

Let a glass ball filled with oxygen gas be placed in the receiver of an air pump in which the vacuum is made as perfect as possible. If this ball is then broken within the receiver by a suitable apparatus, a brilliant light will be produced when the room is darkened. This curious experiment was first made by M. Biot.

5. *Singular heat in the fusion of tin and platinum.*

Singular heat in the fusion of tin and platinum.

If a small piece of tin foil is wrapped in a piece of platinum foil of the same size, and exposed upon charcoal to the action of the blowpipe, the union of the two metals is accompanied by a rapid whirling, and by an extraordinary brilliancy in the light which is given out. If the globule thus melted is allowed to drop into a bason of water, it will remain for some time red hot at the bottom of it, and the intensity of the heat is so great that it swells and carries off the glaze of the part of the bason on which it falls. This experiment is described by Mr. Fox in the *Ann. of Phil.* June 1819.

6. *Method of colouring agates.*

Method of colouring agates.

A variety of agates that have been highly prized by amateurs have been brought from India, and more recently from Germany; and as all these derive their beauty from an artificial process which is easy in its application, an account of it will be interesting to the scientific reader.

Those which have been most valued are Zoned agates, in which the laminae are alternately black and white. In order to produce this fine effect, the agate is boiled in oil; some of the veins or laminae absorb the oil more than others, and some of them not at all, so that when sulphuric acid is applied to the specimen, the absorbed oil is blackened, and hence there is an alternation of black and white and sometimes brown veins; the blackest being those which have absorbed most oil, and the whitest those that have absorbed none at all.

In specimens of agates where no veined structure is to be seen, the veins may be rendered visible by this process.

The oil absorbed during the polishing of the agates upon the lapidary's wheel is often sufficient for these purposes.

Black agates have been brought from India coloured with fine lines of white, and also cornelian beads having reticulations of a white colour penetrating to a small depth within the stone and equally hard. These white lines are made by drawing the lines on the stone with a solution of carbonate of soda and exposing it to the heat of a furnace or a crucible. An opaque white enamel is thus produced. Flat white laminae are sometimes produced in this way for cameos.

Cornelians of a dingy yellow colour may be made of the most beautiful red, merely by exposing them in a crucible with sand to a heat under redness.

We have seen specimens of the Iceland chalcedony of a very large size, which showed no appearance whatever of concentric laminae, display their structure in the most beautiful manner, after they had been nearly destroyed by an intense heat.

7. *Glass of different colours produced from straw.*

The celebrated Swedish chemist Assessor Gahn, who first pointed out the use of the blowpipe in analytical researches, used to show the curious experiment of obtaining by its aid iron from a piece of paper. Mr. Sivright of Meggetland, by the aid of the same instrument, without any addition, obtained a colourless globule of glass from a stalk of wheat straw. When barley straw was used he obtained a glass of a topaz yellow colour. As straw contains a great deal of silex, the glass thus produced is formed of the silex and the potash in the straw.

8. *Sugar produced from old rags, sawings of wood, and paper.*

This is one of the most curious chemical discoveries of modern times. It was made by M. Braconnot. If a certain quantity of rags, paper, or the sawings of wood, are heated with sulphuric acid concentrated by cold, the mass has the appearance of being carbonised, but this appearance arises from a stratum of black powder which covers it, and which, when removed by washing, is converted into a true gum, resembling in many respects gum arabic, and likely to be of some use in the arts. This gum is separated from the sulphuric acid in excess by means of carbonate of lime, and it remains in the liquor. When this gum is afterwards treated with boiling diluted sulphuric acid, at 30° or 40° *it is converted into true sugar of grapes, the quantity of which is greater than that of the linen, or the paper, or the sawings of wood employed.*

9. *Hydro-Pneumatic Lamp.*

The discovery of M. Dobereiner of the remarkable action of spungy platinum upon hydrogen gas, has led to the construction of an elegant lamp for producing instantaneous light.

This lamp was, we believe, first made for sale by Mr. Garden of London; but it has since been constructed in an improved form by Mr. Adie, optician in this city.

The form given to the lamp by Mr. Garden is shown in Plate CCCCLXXXV. Fig. 2, where AB is a glass globe fitting tightly by a ground shoulder into the neck *m n*, of another globe or vessel CD. The globe AB terminates downwards in a hollow neck, *m n o p*, in the lower end of which is placed a small cylinder of zinc *o p*. Into the neck of the vessel CD is fitted a brass piece, *a b c*, through which the gas contained in CD can escape at the point *c*, by turning a cock *d*. An arm *e f* slides through *h*, and carries in a brass box P a piece of the spungy platinum, which can be brought nearer to *c*, or removed from it by sliding the arm *e f* through *h*.

If we now pour diluted sulphuric acid into the vessel AB by the mouth at S, it will descend through the neck *m n*, compressing the air in CD if the cock *d* is shut. The diluted acid will now act upon the ring of platinum, *o p*, and produce hydrogen gas, which, after the common air in CD is let off, will gradually fill the

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* The two preceding articles, copied from the *Edinburgh Journal of Science*, Vol. I, were, we believe, written by Dr. Brewster.

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vessel CD. When the gas is thus collected in the vessel CD, a stream of it may at any time be discharged through the aperture *c*, and thrown upon the spungy platinum P, when it will produce such an intense heat as to make the platinum red hot, and thus afford an instantaneous light.

In Mr. Garden's lamp, the ring of zinc *o p* floats upon a piece of cork, so that when the vessel CD is filled with gas, the dilute acid does not touch the zinc, and consequently no more hydrogen is produced; but the moment any of the gas is let off at *c*, the pressure of the head of fluid in AB overcomes the elasticity of the remaining gas in CD, and the diluted acid is forced up to the zinc, to reproduce the wasted hydrogen.

By this ingenious contrivance, the diluted acid is pressed up against the zinc when more hydrogen is wanted, and withdrawn from it when the vessel CD is full.

The form given to the lamp, by Mr. Adie of this city, is shown in Fig. 3. No. 2. where the different parts are marked by the same letters as in Fig. 3. In this construction, a cone of glass *k* formed on the bottom of the vessel AB is made to hold the ring of zinc, *o p*, which remains permanently in that position. This lamp has the advantage of greater stability, and is less liable than the other to be deranged by an accidental cause.

Professor Cumming of Cambridge, who constructed one of these lamps in December 1823, found it necessary to cover up the platina with a test tube, or a cap, after every experiment. With platina foil $\frac{1}{3367}$ of an inch in thickness, and kept in a close tube, he produced the same effect; but when the thickness of the foil was $\frac{1}{6110}$, it was necessary to raise it previously to a red heat.

These lamps, besides their extreme beauty as philosophical toys, are of great use in counting houses, as well as in private houses, in summer, when there is no fire at which a taper can be lighted.

10. *Lamps without flame.*

A lamp without flame which was first constructed by Mr. Ellis, has been already fully described in our article LAMP, Vol. XII. p. 509. As no drawing of it is given under that article we have thought it proper to represent it in Plate CCCCLXXXV, Fig. 4, where AB is the lamp containing ether or alcohol, and *h* the coil of platinum wire the hundredth part of an inch thick. A thin sheet of platinum or palladium will produce the same effect.

11. *Dobereiner's natural lamp by Incandescence.*

In using a spirit of wine lamp, M. Dobereiner observed, that when the spirit of wine was nearly consumed, the wick became carbonised, and though the flame disappeared, yet the carbonised part of the wick became incandescent, and continued red while a drop of alcohol remained, provided the air in the apartment was tranquil. In one experiment it continued red twenty-four hours; a disagreeable acid vapour, however, was formed.

Dr. Brewster long ago observed an analogous fact in the small green wax tapers in common use. When the flame is blown out, the wick will continue red for many hours, and the wax and wick are burned down as in its ordinary combustion, only with extreme slowness; a very disagreeable vapour being formed during the imperfect combustion. Dr. Brewster has observed also that the same effect is not produced when the taper is made of *red wax*. This probably arises from the colouring matter of the two tapers. There can be little doubt, however, that the same result will be obtained with different kinds of wax, and even with tallow, provided the quantity of wax is properly proportioned to the diameter of the wick.

12. *On the two new Fluids in the cavities of gems.*

On the two new fluids in the cavities of gems.

Two new fluids, possessing extraordinary physical properties, have been recently discovered by Dr. Brewster, in the crystallized cavities of gems, as *topaz*, *quartz*, *amethyst*, and *chrysoberyl*. These cavities frequently occur in millions in a single specimen, and they are often so minute as to escape the cognizance of the highest magnifying powers.

The two fluids are in general perfectly transparent and colourless, and they exist in the same cavity, in actual contact, without mixing together in the slightest degree. One of them expands *thirty* times more than water; and at a temperature of about 80 degrees of Fahrenheit, it expands so as to fill up the vacuity in the cavity. When the vacuity is large in proportion to the quantity of fluid, a little additional heat converts it into vapour, which exhibits, in its formation and condensation, a series of beautiful optical phenomena. This fluid is also singularly voluble, so that a cavity with rectilineal sides forms a most delicate microscopic level.

The *second* fluid, which invariably accompanies the first, is not more expansible than common fluids. It occurs in smaller quantities than the first fluid, and has a higher refractive power.

Dr. Brewster has succeeded in taking these fluids out of their cavities, and in examining their properties when exposed to the open air. The first fluid contracts and expands in the most rapid manner, as if it consisted of particles endowed with vitality; and both of them indurate into a sort of a resinous substance, a state in which they often appear even when they are imprisoned in their cavities.

The existence of these two fluids to such an extent in minerals, and their occurrence with precisely the same properties in specimens brought from such opposite regions as Scotland, Siberia, New Holland, Brasil, and Canada, renders it probable that they have performed some important function in the mineral organizations of our globe.

PLATE CCCCLXXXV. Fig. 5.

In order to give the reader some idea of the appearance of these two new fluids as coexisting in the same cavity, let AB, Plate CCCCLXXXV, Fig. 5, represent one of the cavities in topaz as seen through a microscope, or even by the naked eye, (for some of them are sufficiently large to be seen by the naked eye) then there will be observed a circular vacuity V in the fluid EF, and the fluid EF will be seen bounded by two lines *m n*, *o p* which separate it from the other fluid CD. When the heat of the hand is applied, or a heat so low as 74°, the vacuity V gradually grows less from the expansion of the fluid EF, and it soon disappears. The fluid CD, however, is not all perceptibly expanded by the same heat, as appears from the boundaries *m n*, *o p* remaining stationary. When the topaz cools, the fluid EF contracts, and the vacuity V re-appears and enlarges. If the cavity is deep, the vacuity V re-appears with a violent effervescence, but the various vacuities or bubbles thus formed speedily unite into one. When the cavity is shallow the vacuity V often re-appears in two or three vacuities which unite into one.

The refractive power of the expansible fluid EF is much lower than water or any known fluid, and that of the other fluid CD is a little less than water. Small spicular crystals are sometimes found in these cavities. See the *Edinburgh Transactions*, Vol. X. p. 1. and Dr. Brewster's *Journal of Science*, Vol. IV.

13. *On the Condensation of Gases into liquids by their own pressure.*

On the condensation of gases into liquids by their own pressure.

The condensation of gases into liquids discovered by Mr. Faraday, is one of the most curious experiments in modern chemistry. The gas with which the experiment may be most easily and safely made, is *Cyanogen*. For this purpose take some pure cyanuret of mercury, made perfectly dry by heating, and having put it into one branch of a glass tube bent like the letter A, the branches being about two inches long, seal the other end of the tube hermetically. If the heat of a spirit lamp is applied to the end of the tube containing the cyanuret, while the other is kept cold, the cyanogen gas will be produced by the decomposition of the cyanuret and passing over into the cool end of the tube will be condensed by its own pressure or expansive power into a pure and colourless fluid, having a refractive power rather less than water. The pressure of the vapour of cyanogen appeared to be a little more than three and a half atmospheres at 45° of Fahrenheit.

By a process similar to the preceding, Mr. Faraday succeeded in liquefying *sulphurous acid gas, sulphuretted hydrogen, carbonic acid, euchlorine, nitrous oxide, ammonia, muriatic acid, and chlorine.* See *Philosophical Transactions*, 1823, p. 189.

Sir Humphry Davy has also used a very simple method of liquefying the gases by means of heat. He places the gas in one leg of a bent tube confined by mercury, and applies heat to ether, alcohol, or water put in the other end of the tube. By the pressure of the vapour of these fluids he liquefied Prussic acid gas and sulphurous acid gas. See *Philosophical Transactions*, 1823, p. 199.

14. *Remarkable experiment on the expansion of ether.*

Remarkable experiment on the expansion of ether.

Take a tube of glass about two inches long and three-tenths of an inch in diameter, and fill it about three-fifths full of ether. Fix the tube by means of a wire to a piece of stick about two feet long, and hold the ball either over a spirit lamp or within the bars of a good fire, turning it round so as to receive the heat equally. The ether will be seen to expand, and when the heat is about 300°, the ring of fluid which adheres to the glass by capillary attraction, becomes smaller and smaller and the fluid more and more voluble, till it at last fills the whole tube, the ether having expanded two-fifths of its original bulk. When the tube is allowed to cool in a vertical position various currents ascending and descending appear, and then a cloud suddenly shows itself at within less than two-fifths of the tube from its top, accompanied by a rapid ebullition, which announces the conversion of the vapour which filled the tube into liquid.

This experiment is exceedingly curious, and we have performed it repeatedly and shown it to others with no other precaution than holding the tube behind a thick plate of mica in case of its bursting.

The same results take place whether atmospheric air occupies the two-fifths of the tube that is left empty, or whether the air is driven off by the ebullition of the ether.

The part of this experiment respecting the expansion of the ether so as to fill the tube is due to Baron Cagnard de la Tour.

15. *Protection of the copper of ships and of culinary utensils by rendering it negatively electrical.*

Sir Humphry Davy had long ago shown, that the chemical action of bodies upon each other may be modified or destroyed by changes in their electrical states; that substances will combine only when they are in different electrical states; and that by bringing a body naturally positive, artificially into a negative electrical state, its usual powers of combination are altogether destroyed. By reasoning upon this general principle, which had previously conducted him to many brilliant discoveries, Sir Humphry was led to the discovery which we propose at present to explain. Copper being a metal only weakly positive in the electro-chemical scale, he conceived that if it could only act on sea water in a positive state, and consequently that if it could be rendered slightly negative, the corroding action of sea water upon it would be destroyed. After many trials, he obtained the most satisfactory confirmation of these theoretical views. A piece of zinc as large as a pea, or the point of a small iron nail, preserved 40 or 50 square inches of copper from corrosion, whether it was placed at the top, bottom, or on the middle of the sheet of copper, and whatever was the shape of the copper. Every side, every surface, and every particle of the copper continued bright, while the zinc or the iron was slowly corroded.

A piece of thick sheet copper, containing about 60 square inches of surface, was cut, so as to form seven divisions, connected only by the smallest filaments, and a mass of zinc, of the fifth of an inch in diameter, was soldered to the upper division. The whole was plunged under sea water, and after the lapse of a month the copper was as bright as when first introduced, while similar pieces of copper undefended had undergone considerable corrosion.

The application of these results to the preservation of the copper sheeting of ships of war and other vessels is obvious. Under the sanction of the Lords Commissioners of the Admiralty, Sir Humphry has been engaged in ascertaining the value of this discovery upon ships of war, and we learn with the happiest effect.

The Samarang, which had been coppered in India, in 1821, came into dock in the spring of 1824, covered with rust, weeds, and zoophytes. She afterwards set out for Nova Scotia, protected with four masses of iron, equal in surface to about *one-eightieth* of the copper, two being placed near the stern, and two on the bows. She returned in January 1825, remarkably clean, and in good condition.

All vessels of copper, used in cookery may likewise be protected from oxidation, by a piece of tin or iron. See the *Phil. Transactions*, 1824, p. 151; and Dr. Brewster's *Journal of Science*, vol. I.

16. *On the singular effects of intoxicating gas.*

The intoxicating gas, otherwise called the nitrous oxide, or the gaseous oxide of azote, is, like atmospheric air, a compound of oxygen and nitrogen gas, and differs from it only in having a greater quantity of oxygen, and from being composed of 27 parts of oxygen and 73 of nitrogen, while the nitrous oxide is composed of 37 parts of oxygen and 67 of nitrogen.

In order to procure the nitrous oxide, nitrate of ammonia is put into a tubulated glass retort, and exposed to the heat of an Argand's lamp, not exceeding 500°. The nitrous oxide is disengaged along with watery vapour which condenses in the neck of the retort, while the gas is received over water. It is generally white, and therefore when it is to be used for the purpose of respiration, it should be permitted to remain at least an hour in contact with water, which will absorb the small quantity of nitrate of ammonia and of acid which adheres to it. In this way about five cubic feet of gas will be got from about a pound of the nitrate.

The curious property which this gas possesses of producing, when inhaled, a very remarkable species of intoxication, was discovered by Sir H. Davy. "I breathed," says Sir Humphry, "three quarts of nitrous oxide from, and into a silk bag for more than half a minute, without previously closing my nose or exhausting my lungs. The first inspiration caused a slight degree of giddiness. This was succeeded by an uncommon sense of fullness of the head, accompanied with loss of distinct sensation and voluntary power, a feeling analogous to that produced in the first stage of intoxication, but unattended by pleasurable sensation." In describing the effect of another experiment, he says, "having previously closed my nostrils, and exhausted my lungs, I breathed four quarts of nitrous oxide from, and into a silk bag. The first feelings were similar to those produced in the last experiment, but in less than half a minute, the respiration being continued, they diminished gradually, and were succeeded by a highly pleasurable thrilling, particularly in the chest and the extremities. The objects around me became dazzling, and my hearing more acute. Towards the last respiration the thrilling increased, the sense of muscular power became greater, and at last an irresistible propensity to action was indulged in. I recollect but indistinctly what followed; I knew that my motions were varied and violent. These effects very soon ceased after respiration. In ten minutes I had recovered my natural state of mind. The thrilling in the extremities continued longer than the other sensations. This experiment was made in the morning; no languor or exhaustion was consequent, my feelings through the day were as usual, and I passed the night in undisturbed repose."

Soon after Sir H. Davy made these experiments, the nitrous oxide was inhaled by various persons with various effects. In some it produced convulsion; in others it attacked the intellectual functions; in many it produced an irresistible propensity to muscular exertion; and in some it had no sensible effect, though breathed perfectly pure and in considerable quantities.

Two very remarkable cases which occurred among his own students, at Yale College, have been recorded by Professor Silliman, who witnessed the effects that were produced.

"A gentleman about 19 years of age, of a sanguine temperament and cheerful temper, and in the most perfect health, inhaled the gas, which was prepared and administered in the usual dose and manner. Immediately his feelings were uncommonly elevated, so that, as he expressed it, he could not refrain from dancing and shouting. To such a degree was he excited that he was thrown into a frightful delirium, and his exertions became so violent that he sunk to the earth exhausted; and having there remained till he in some degree recovered his strength, he again rose only to renew the most convulsive muscular efforts, and the most piercing screams and cries, until, overpowered by the intensity of the paroxysms, he again fell to the ground, apparently senseless and panting vehemently. For the space of two hours these symptoms continued; he was perfectly unconscious of what he was *doing*, and was in every respect like a maniac: he states, however, that *his feelings* vibrated between perfect happiness and the most consummate misery. After the first violent efforts had subsided, he was obliged to lie down two or three times from excess of fatigue, although he was immediately aroused upon any one entering the room. These efforts remained in a degree for two or three days, accompanied by a hoarseness which he attributed to the exertions made when he was under the influence of the gas.

The other case was that of a man of maturer age, and of a grave character. For nearly two years previous to his taking the gas his health had been very delicate, and his mind so gloomy and depressed that he was obliged almost entirely to discontinue his studies. In this state of debility he inhaled about three quarts of the nitrous oxide. The consequences were, an astonishing invigoration of his whole system, and the most exquisite perception of delight. These were manifested by an uncommon disposition for mirth and pleasantry, and extraordinary muscular power. The effects of the gas were felt without diminution for at least thirty hours, and in a greater or less degree for more than a week; but the most remarkable effect was upon the organ of taste. Before taking the gas, he felt no peculiar choice in the articles of food, but immediately after he *manifested a taste for such things only as were sweet*, and for several days he ate *nothing but sweet cake*. Indeed this singular taste was carried to such excess, that he *used sugar and molasses not only upon his bread aud butter and lighter food, but upon his meat and vegetables*, and this he continues to do at the present time, although nearly eight days have elapsed since he inhaled the gas. His health and spirits since that time have been uniformly good, and he attributes the restoration of his strength and mental energy to the influence of the nitrous oxide. He is quite regular in his mind, and now experiences no uncommon exhilaration but is habitually cheerful, while before he was habitually grave, and even to a degree gloomy.

17. *To produce a fine purple gas from Iodine.*

To produce a fine purple gas from Iodine.

Iodine is a very remarkable substance, obtained from kelp, the properties of which has been very fully detailed in our article on IODINE, vol. xii. p. 191. If we take some of the crystals of this substance, and put them in a glass tube, about 3-4ths of an inch wide, or indeed any width, and four or five inches long, and then hold the tube to the fire, the crystals of iodine will evaporate into a fine purple gas which fills the tube. As soon as the tube cools the gas again deposits itself in small crystals.

18. *Remarkable explosion of gas in a well.*

Remarkable explosion of gas in a well.

In our article on *Coal* MINES, we have already given an account of some of those numerous explosions of carburetted hydrogen gas, which sometimes take place in coal mines; and of the beautiful safety lamp of Sir H. Davy, by the use of which these explosions may be guarded against.

In the course of the present year a phenomenon of a very remarkable kind, and the more remarkable for its being entirely unexpected, and without any example, took place near Edinburgh, on the 28th April 1825. The following distinct account of it by Mr John Coldstream, is published in Dr Brewster's *Journal of Science*, vol. iii. p. 104.

"About three months since, a bore for a well was commenced in Cannon Street, near Leith Fort. Nothing particular was observed to occur in the course of the workings, till Thursday the 28th ult. when the depth of 87 feet from the surface had been attained, without finding water. The bore had been sunk to this depth, through seven feet of vegetable soil and sand, and 80 feet of a very stiff dark-coloured clay, containing imbedded, numerous rounded pebbles of quartz, chlorite slate, hardened sand-stone, and coal. On the morning of the 28th, at half-past six the two men, who had hitherto wrought at the bottom of the bore, went down, as usual, without lights, and commenced their labours. In the course of an hour after this, while driving their jumper (three inches broad), perpendicularly through the clay, they suddenly found it slip down about six inches, into an open space. Immediately, through the hole, thus made by the jumper, there issued with tremendous violence, and terrific noise, a vast quantity of some air, which, rushing past the workmen in the bore, ascended with such velocity, as to carry along with it masses of the clay of considerable size. The men below, instantly prepared to ascend, and one having got into the bucket was drawn up without delay, and the rope again lowered for the other one. He was seen to get into the bucket, and was drawn up about thirty feet, when it was observed that he appeared as if dead, and leaning over the bucket, so as to be in danger of falling out altogether. The men, therefore, above, fearful of his falling down and being killed, instantly lowered the bucket again; and one of them, ignorant of its being noxious air that had burst from its confinement, slid down on the rope, still without a candle, to see what was the matter with his comrade; on finding, however, his breathing beginning to be affected, he returned to the mouth of the bore. A lighted candle was now procured, and brought to the mouth of the pit; no sooner had its flame reached the level of the ground, over the bore, than the whole air in the pit inflamed and exploded with a report as loud as that produced by firing a large piece of ordnance; the flames rose to the height of forty feet and more from the pit's mouth, and are described as having been of a blue colour. A strong sulphureous odour was immediately perceptible.

It was not until two hours after this explosion, that the unfortunate man was drawn out; he was quite dead—his clothes were but little injured by the flames. Those who were standing near, or over the mouth of the bore, at the time of the explosion, got themselves much scorched, and otherwise hurt. The whole neighbourhood was violently shaken, but no windows were broken by the shock.

No work was done in the pit for a week after this occurrence; but on the eighth day after, a candle was again brought to the pit's mouth, when immediately a second explosion, not quite so violent as the first, but of the same character, ensued; nor could the men venture down for several days; and the gas collected in such quantity, that, for about a week after this, it was exploded every morning; and the men found that the quantity collected seemed to be greater in wet than in dry weather. On continuing the workings at the bottom of the bore, it was seen that the jumper used by the deceased and his companion, had penetrated a large cavity, situated immediately under the clay, and having for its floor a stratum of soft bituminous shale, called by miners blaize. In this cavity, therefore—the size of which could not be exactly ascertained,—the gas seems to have been confined. By the 29th of May they had got about ten feet below the surface of the shale, and still the gas continued to escape through the shale from the floor of the pit; in quantities, however so small, as not to prevent the miners from working all day; they now complain more of the loathsome sulphureous odour, which they still experience at the bottom of the pit, than of any difficulty in breathing. The pit is now 100 feet deep, and no water has been found. Its mouth is situated about fifty yards from, and is elevated about twelve feet above high water mark."[1]

DYNAMICS.

1. *Experiment showing the Equal Action of Gravity on Light and Heavy Bodies.*

In order to exhibit the equal action of gravity on light and heavy bodies, it was formerly necessary to have recourse to the vacuum of an air-pump, and the celebrated experiment of the guinea and the feather falling with the same velocity in the receiver, has been displayed for centuries.

The late M. Benedict Prevost devised the following simple experiment, which proves the equal action of gravity by proving that the retardation in the fall of light bodies arises solely from the resistance of the air. Place a piece of thin paper on the bottom of a small box, of such a weight that in falling the bottom of it will always keep lowermost. Let the box now fall from the height of eight or nine feet above a cushion, and the paper and the box will both reach the cushion at the same time, just as if the paper had clung to the bottom of it. If the same piece of paper is allowed to fall by itself from the same height, it will flutter slowly and obliquely to the floor. The experiment will succeed equally well if the piece of paper is placed upon a crown or half crown piece without using a box. The rapid descent of the paper when placed on the box is in no way owing to any adhesion between it and the bottom of the box, but to the circumstance of there being no air to obstruct its descent, the advance of the box in front of the paper having the same effect as if there was a perfect vacuum before the piece of paper. A little box of lead or piece of lead with round edges is best for making the experiment.

One of the most curious dynamical experiments which has been witnessed in modern times, is the descent of trees with the rapidity almost of lightning along the celebrated slide of Alpnach, of which we shall give a full description under the article SLIDE in Vol. XVIII.

ELECTRICITY AND GALVANISM.

In our articles on ELECTRICITY, Vol. VIII. p. 411, and GALVANISM, Vol. X. p. 79, we have given such a copious detail of the remarkable experiments which these two sciences embrace, that there is little occasion for any resumption of the subject under the present article, unless to give an account of some of the more popular discoveries which have been made since these articles were printed.

1. *On the Pyro-Electricity of the Tourmaline.*

The general phenomena of the pyro-electricity of the tourmaline have been already described under ELECTRICITY, Vol. VIII. p. 456.

In pursuing his experiments on this curious subject, M. Haüy found that the electricity developed by heating *tourmaline* and the *siliceous oxide of zinc*, instead of disappearing, as had been supposed, in an abrupt manner at the ordinary temperature, had only reached the point or node through which it passed into an opposite state by a farther reduction of temperature. By the application of cold, therefore, to the tourmaline and oxide of zinc, he determined that the pole which possessed *vitreous* electricity when *hot* developed *resinous* electricity when *cold*.[*]

It has been shown by Dr. Brewster, *Edinburgh Journal of Science*, vol. i. p. 211, that the electricity of *tourmaline* may be exhibited in a very satisfactory and simple manner by means of a thin slice taken from any part of the prism, but particularly when its surfaces are perpendicular to the axis of the prism. The slice is then placed upon a piece of well polished glass, and the glass heated to a considerable degree. About the heat of boiling water the slice will adhere to the glass so firmly, that even if the glass is above the tourmaline, the latter will adhere to it for five or six hours. In this way slices of very considerable breadth and thickness will develope as much electricity as is capable of supporting their own weight.

In order to show the electrical phenomena of the tourmaline to great advantage, by combining the action of its two poles, Mr. Sivright fitted up a crystal so as to resemble the letter D, with an opening in its round side. The straight part of the letter represents the crystal, and the two curved portions are pieces of silver wire rising out of two silver caps, one of which embraces each pole of the tourmaline. If a fifth ball is suspended at the opening between the ends of the wires, it will vibrate in a beautiful manner in consequence of their opposite actions.

Sir Humphry Davy has stated, *Elements of Chemical Philosophy*, vol. i. p. 130, that "when the stone is of considerable size flashes of light may be seen along its surface."

2. *On the Existence of Pyro-Electricity in various Minerals.*

The subject of the pyro-electricity of minerals has been recently examined by Dr. Brewster, *Edinburgh Journal of Science*, vol. i. p. 208. The following list of pyro-electrical minerals shows the minerals in which pyro-electricity has been discovered by preceding observers.

Minerals.	Observers.	Minerals.	Observers.
Tourmaline,	*Lemery.*	Mesotype,	*Haüy.*
Topaz,	*Canton.*	Prehnite,	
Axinite,	*Brard.*	Oxide of zinc,	
Barcite,	*Haüy.*	Sphene,	

In order to determine the existence of pyro-electricity in minerals where it had little intensity, Dr. Brewster employed the thin internal membrane of the *Arundo Phragmites*, which was cut with a sharp instrument into the smallest pieces. These minute fragments were well dried, and the pyro-electricity of any mineral was determined by its power of lifting one or more of these light bodies after the mineral had been exposed to heat. He used also a delicate needle of brass, the pivot of which moved upon a highly polished cap of garnet, and which was affected by very slight degrees of electricity.

In this way he determined the pyro-electricity of the following minerals:

Scolezite.[†]
Mesolite.[†]
Greenland mesotype.
Calcareous spar.
Beryl yellow.
Sulphate of barytes.
Sulphate of strontites.
Carbonate of lead.
Diopside.
Fluor spar, red and blue.
Diamond.
Yellow orpiment.
Analcime.
Amethyst.
Quartz dauphiny.
Idocrase.
Mellite ?
Sulphur Native.
Garnet.
Dichroite.

3. *On the Existence of Pyro-Electricity in Artificial Crystals.*

On the existence of pyro-electricity in artificial crystals.

It does not appear from any of Haüy's writings, that he even suspected the existence of pyro-electricity in crystals formed by aqueous solution. In subjecting some of these to experiment, Dr. Brewster was surprised to find that they possessed this property, and some of them to a considerable degree. The following is a list of those in which he discovered it:

Tartrate of potash and soda.
Tartaric acid.
Oxalate of ammonia.
Oxymuriate of potash.
Sulphate of magnesia and soda.
———— ammonia.
———— Iron.
Sulphate of magnesia.
Prussiate of potash.
Sugar.
Acetate of lead.
Carbonate of potash.
Citric acid.
Oxymuriate of mercury.

Among the preceding crystals, the *tartrate of potash and soda*, and the *tartaric acid*, are pyro-electrical in a very considerable degree; but the action of several of the other salts is comparatively feeble.

4. *On the Pyro-Electricity of the Powder of Tourmaline.*

On the pyro-electricity of the powder of tourmaline.

Among the curious properties of artificial magnets, none is more remarkable than that which is exhibited by cutting a piece from one of their extremities. If the piece is taken from the north pole of the magnet, it is itself a regular magnet, with north and south polarity. The very same property was discovered in the tourmaline by Mr. Canton, who found that, if it was broken into two parts when in a state of excitation by heat, each fragment had two opposite poles. Coulomb has ingeniously explained the magnetical fact, by supposing that each particle of the magnet is itself a magnet with opposite polarities; and Haüy has applied the same explanation to the analogous phenomena in the tourmaline.

If we attempt, however, to reduce the magnet into minute portions by any mechanical operation, such as filing, pounding, &c. the particles of steel are found to be deprived of their magnetical qualities, their coercive power being destroyed by the vibrations or concussions which are inseparable from the process of comminution. Analogy would lead us to expect the same result with the tourmaline; and we have no doubt that most philosophers, confiding in the force of recognised analogies, would expect that the powder or dust of pounded tourmaline would not exhibit any pyro-electrical phenomena.

In order to ascertain this point, Dr. Brewster pound-

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[*] Our countryman Mr. Canton seems also to have discovered this point long ago.

[†] It is probable that the *mesotype* of Haüy was one or other of these two minerals.

Science, Curiosities in.

On the summit of Ben-Nevis, about mid-day, the thermometer, with wet bulb, stood at 36° 5° Fahr. in the cloud. The temperature soon after rose to 39°, and the cloud in which we stood was partly evaporated; partly borne away, leaving a view of the sublime scenery by which we were surrounded. The dense clouds on every side hung down like curtains around the panorama, and their under margins were so definite, and the atmosphere otherwise so clear, that one felt disposed to stoop down as if to see farther into the distant landscape, which was illuminated by the sunshine. The altitude of this magnificent accumulation of vapour, was between 3000 and 4000 feet above the level of the sea. But it was far from uniform, at least the profile of its under surface was alternately elevated and depressed, so that at one time we saw beneath it the mountains of Perthshire and the Hebrides; and, in a few minutes after, our view was confined to the valleys surrounding Ben-Nevis. Soon after mid-day, the weather became more unsettled. Sometimes a cloud rose suddenly on the face of the mountain, and rolled down the valley. Sometimes one came from the neighbouring summit of Corry-Rignson, as if urged by a violent wind; and at other times the condensed vapour ascended rapidly in immense volumes from the centre of the valley below, and was aptly compared by one of the party to the smoke from a town on fire. The magnificence and variety of these clouds amply compensated for the loss of the terrestrial scenery.

The summit of Ben-Nevis, for a considerable extent, was covered with snow. Not only was there a ravine in the immense precipice on the north side of that mountain, containing an upfilling of snow almost entitled to the name of a glacier, and several beds of great depth lying fully exposed to the sun; but there was a general covering of about three inches depth, which had fallen since the same party was there two days before. This was easy to be conceived, for about one o'clock, the temperature fell to 33°.5, a fresh breeze having arisen from the south-east, bringing a nimbus along with it. When the storm reached us, it proved to be snow, which continued to fall very heavily for about two hours. Soon after it began, our attention was attracted by a very singular noise, which was heard every where around us. It exactly resembled the hissing sound which proceeds from a point on an excited prime conductor, or a strongly-charged Leyden phial of an electrical apparatus, indicating the emission of a pencil of electric light, which, had the daylight not overpowered it, would certainly have been visible. This sound was always loud, and more or less distinct for about an hour and a half. It seemed to proceed from every point near us. But amidst the general hissing, I was convinced that I could specify the summit of my umbrella and several points of the rocks from which I heard it issuing. On removing to the cairn on the highest point of the mountain, the phenomenon became remarkably manifest, and we could almost determine the stones from which the pencils were proceeding.

Though this sound of the electric fluid is so completely *sui generis*, as scarcely to be confounded with any thing else, an accident now occurred, which afforded another evidence of the nature of the action which occasioned it, when we were seeking for none. One of the party having fallen behind the rest, in examining some parts of the mountain, came up to the others while they were wondering at the sound, and trying to find shelter from the storm beside the cairn; and were it not, that complacency and fortitude are unalterably expressed in his countenance, we should certainly have concluded, either that he had seen "the angry spirit of the storm," or something else very terrific; for, as is always stated of persons having witnessed such sights, "steterunt comæ,"—the hair of his head stood on end—not indeed all his hair, but those locks only which enjoyed something of their natural freedom to move, having withstood the pelting action of the snow and rain several hours. For botanists, contrary to the practice of the vulgar, sometimes find it more convenient to wear their caps in their pockets. Several other gentlemen, then, by uncovering their heads, gave their hair an opportunity of exhibiting the beautiful phenomena of electrical attraction and repulsion.

ELECTRO-MAGNETISM.

The new science of Electro-Magnetism which has been established since our articles Electricity and Magnetism were printed, affords a series of most amusing and interesting experiments.

As we propose to give a full account of the whole subject under the article Thermo-Electricity, it would be unnecessary to anticipate any of the details under the present article.

HOROLOGY.

1. *An account of Breguet's eye piece chronometer for counting fractional parts of a second.*

In observing the disappearance of a star behind the wires of a transit instrument, it is not easy to observe to the *fifth* part of a second of time; but as this quantity corresponds to *three seconds* of right ascension it becomes a matter of considerable consequence to distinguish even tenths of a second.

The instrument by which M. Breguet proposes to supply this defect is shown in Plate CCCCLXXXV, Fig. 6, where AB is a section of the eye piece of a telescope through the anterior focus of the eye glass, the field bar being represented by the black ring. The box CD attached to it contains a chronometer which points out on the dial plate EF, by means of the index G, every ten seconds, the dial plate being divided into ten minutes. Two other indices *m n*, revolve through the field of the telescope, and in the plane of the wires. The shorter one, *n*, marks units or single seconds upon a segment of a circle *o p* of 60° divided into ten seconds. The larger index, *m*, terminates in an opaque disc, the centre of which describes in one second a segment of 60°, which may be divided into ten parts or tenths of seconds. The prolongations of the divisions 1, 3, 5, 7, 9, determine the distances of the wires in the field, so that they may give their aid in estimating the divisions of the scale. The coincidence of the disc with one of the wires, or its situation in the middle of one of the intervals between the wires indicates one, two, or three tenths of a second. All the indices move in the same direction as the star, and there is a detent for stopping the wheel work, and a lens near the eye for enabling it to read off the minutes, and the tens of seconds on the dial-plate EF.

In order to use this instrument the minutes and tens of seconds are first observed on the dial plate EF, a few seconds before the star reaches the wires, then by raising the eye to the field of the telescope, the shortest needle *n* points out the units of seconds which are to be added. The eye of the observer must now be fixed solely upon the star which is about to pass behind the first wire, and he reckons fractional parts of the seconds by observing laterally and indirectly the passage of the disc *m* over the divisions from 0 to 10.

M. Breguet has not yet published any account of the interior arrangements of the chronometer.

2. *Description of Rieussec's Chronograph.*

This piece of watch-work was invented by M. Rieussec in 1821, and has been greatly improved by M. Breguet. The object of it is to record on the dial plate the fractions of seconds at any instant of time, so that it enables us to determine with great accuracy in seconds and fractions of a second the interval elapsed between any two instants. The needle is supplied with as much of a prepared black colour as will serve for fifty experiments. The instant that we press down a button, the needle deposits a black point on the dial plate during five minutes, so that these points cannot be confounded with one another. This instrument, which is singularly accurate, has a dial plate with second and minute hands. In M. Rieussec's instrument printer's ink is used for marking the points, and the instantaneous contact of the point has no influence on the motion of the dial, which is moveable. In Breguet's, the dial seems to be fixed.

3. *Description of Griebel's Portable Night Clock.*

This clock, constructed by M. Griebel of Paris, is represented in Plate CCCCLXXXV. Fig. 7. and Fig. 8. the former showing it in perspective, and the latter in section. A is the globe which contains the clock movement and the lamp B. The dial-plate C has a rim of a round glass with the hours painted upon it between E and C; EE is a plate in the centre of the ground glass ring to which the movement is fixed, and F is a globe to protect the wheel-work from dust. The rays of light BG, BG issuing from the lamp B, illuminate the rim EC of the dial on which the hours and minutes are painted.

It would, we think, be an improvement on this clock to place a mirror between GG, to intercept all the rays that do not fall upon the rim of ground glass, which by means of another mirror behind B, would throw some additional scattered light on the rim itself, while it would protect the wheel-work from the direct radiation of the lamp. See Dr. Brewster's *Edinburgh Journal of Science*, vol. iii. p. 346.

4. *Description of Lenormand's New Chronometer.*

This very singular piece of mechanism, which excited much interest at the expositions of French industry in 1819 and 1823, is represented in Plate CCCCLXXXV. Figs. 9, 10, 11. The principle of this chronometer consists in the continual displacement of the centre of gravity of the arm of a lever. This lever has the form of an arrow AB, Fig. 9. which is capable of moving round a horizontal axis O, fixed in the middle of a dial-plate divided into twelve hours. The two arms AO, BO are unequal, and at the end B is fixed a round box. If we place in the box a small weight, which has the power of moving round the interior circumference of the box, and if it is placed as at B, the arrow will remain in the position AB, and point to IX^h. If the small weight is placed as at D, so as to be at the greatest possible distance from the centre O, the arrow will point to XII^h, and so on at the other quarters, as at E, and F in Fig. 10. In like manner, intermediate positions of the little weight will cause the arrow to point to intermediate hours. If we now could fix in the box a piece of wheel-work to displace this weight in a regular manner, so as to describe the circumference of the box in twelve hours, the arrow AB would revolve in twelve hours, and would point them out on the dial-plate like the hand of a clock. If the wheel-work should carry the weight round the box in an hour, the arrow would mark minutes on the dial. The additional weight which we have introduced for the purpose of explaining the principle of the machine, is not actually used. It exists naturally in every watch, as the centre of gravity of every watch is at a distance from its centre of form, on account of the weight of the main-spring box and fusee. We require, therefore, only to place a watch in the box B, Fig. 10. in such a manner, that it cannot go without communicating its motion to the arrow AB. This may be done in two ways, 1st, The axle of the central wheel, at the place where it comes out of the plate in which it moves, carries a square which is laid hold of by one of the two cross pieces between which the watch is carried, which cross pieces are fixed to the box. The other end of the axle, which is round, moves in a hole perforated in the opposite cross piece. This method, though the most simple, is not always so convenient as the following: 2d, On one of the cross pieces above mentioned is fixed a wheel O, Fig. 11. which cannot turn round. Above the plate of the watch passes the axle of a wheel, on which is fixed a pinion R, which works in the wheel O. The wheel-work actuated by the spring not being able to turn the wheel O, turns quite round it, and, consequently, carries the centre of gravity of the watch quite round the interior circumference of the box B, Fig. 9. and this changes at every instant, and in a regular manner, the centre of gravity of the arrow. If the axle of the wheel, which carries the pinion R, turns round in one hour, and if we wish AB to revolve in twelve hours, then R must have eight teeth, and O 96; or R 10, and O 120. If AB is to revolve in one hour, then R and O must have the same number of teeth. See Baron Ferussac's *Bull. des Sc. Technol*, Jan. 1825, p. 12. or *Edinburgh Journal of Science*, vol. iii. p. 348.

5. *Breguet's Chronometer with Double Seconds.*

Breguet's chronometer with double seconds.

This little contrivance, which is constructed for sale by M. Breguet, has sometimes a dial-plate with two second hands, and sometimes two dial-plates and two second hands. In order to determine any interval of time, the observer, at the commencement of the observation, presses a button, and stops one of the needles, and when the observation is concluded, he again sets the same hand agoing. The difference between the two second hands shows the interval required, an account being kept of the minutes if the interval exceeds 60 seconds.

6. *Breguet's Double Sympathetic Chronometer.*

Breguet's double sympathetic chronometer.

This curious time-piece consists of two independent watch movements in the same box, and without any mechanical communication, having each their separate dials and hands. The two movements *influence each other physically*, and their slight anomalies are reduced more than one half. The continued agreement of the two chronometers is a security against any errors. One of these instruments was submitted by the French Board of Longitude to very severe tests, and even to that of a vacuum; but the two second hands never ceased to beat together to the same fraction of a second. M. Breguet has not explained how the two chronometers influence each other physically; but we have no doubt that they do it by means of the balances, in the same way that two clocks agree with one another, by their pendulums getting into the same train of vibration. Some curious observations on this subject have already been made in our article HOROLOGY, Vol. XI. p. 162.

7. *Breguet's Sympathetic Clock.*

Breguet's sympathetic clock.

This curious piece of mechanism, the construction of which has not been published, has the property of *setting to the proper time*, and regulating a repeating watch made for the purpose. This repeater is carried in the pocket during the day, and at night it is placed above the pendulum in a sort of frame, which forms part of the decoration of the clock.

If the repeater is put wrong so as to go too fast or too slow even for a quarter of an hour, it is sufficient to place it before noon or midnight in its watch frame, in order that at these two times we may see the hands either move forward or backward to the time marked by the clock. The interior regulation of the watch is restored by the same means with as much accuracy as it could be done by an artist after a trial of it for several days.

8. *On the Use of the Common Watch for Philosophical purposes.*

On the use of the common watch for philosophical purposes.

As a watch is often the only time-piece which can be commanded for occasional philosophical purposes, it becomes of some importance to have a method of reckoning short portions of time by it with facility and accuracy. The Rev. Mr. Pearson has shown that (whatever be the numbers of which the wheelwork consists, if we divide double the product of the numbers of teeth in all the wheels from the centre wheel to the crown wheel exclusively, by the product of the hours of all the pinions which engage in those wheels, the quotient will express the number of beats of the watch in one hour. If the quotient is divided by 3600, the number of seconds in an hour, we shall then have the number of beats in one second.

In the above calculation, the wheels and pinions which constitute the dial work are not taken into account, nor the great wheel and pinion with which it acts, because the only use of the former is to cause the hour and minute hands to revolve in their proper time, and the use of the great wheel and pinion is to determine in conjunction with the number of spirals on the fusee the number of hours that the watch will continue to go at one winding up of the chain round the mainspring barrel. The reason why *double* the product of the wheels is used, is that only one tooth of the crown wheel completely escapes from the palates at every two vibrations of the balance.

Let us suppose the watch used to have the following numbers. See HOROLOGY, Plate CCCII. Fig. 1. and Vol. XI. p. 125.

Centre wheel M and pinion *a*,	54—6
Third wheel E and pinion *b*,	48—6
Contrate wheel K and pinion *c*,	48—6
Crown wheel C, . .	15
Palates *p*, *p*, ...	2

Now $\frac{54\times48\times48\times15\times2}{6\times6\times6}=\frac{3732480}{216}=17280$ beats an hour, or 4.75 beats in a second. The number of spirals on the fusee is 7, consequently the number of hours that the watch will go at one winding up, will be $7\times\frac{48}{12}=28$, and the dial-work being $\frac{40}{10}\times\frac{36}{12}=\frac{1440}{120}=12$, shows that while the driving pinion of 10 goes twelve times round, the last wheel of 36 goes only once, and consequently that the angular velocities of the two hands carried by their hollow axles are to each other as 12 to 1.

Mr. Pearson has shown, that a watch with the following numbers will indicate hours, minutes, and seconds by three hands, and give four beats in a second.

Great wheel, ...	50 teeth.
Centre wheel M and pinion *a*,	60—10
Third wheel L and pinion *b*,	64— 8
Contrate wheel K and pinion *c*,	48— 8
Crown wheel C and pinion,	15— 6
Palates *p*, *p*, ...	2

The dial-work as usual. The fusee has six spirals, and the watch goes 30 hours. By the above rule, the beats will be calculated thus:

$$\frac{60\times64\times48\times15}{8\times8\times6}=\frac{5529600}{384}=14400 \text{ beats in an hour,}$$

and $\frac{14400}{3600}=4$ the number of beats in a second. See Nicholson's *Journal*, 4to. vol. iii. p. 49.

9. *Description of some of the Clocks invented by M. Serviere.*

In the cabinet of pieces of mechanism made by the late M. Serviere, there were many clocks invented by himself, and exhibiting much ingenuity. The accounts which have been published of these inventions do not enable us to describe their interior mechanism; but the ingenious artist who sees the effects which are produced, and the external structure of the clocks, can have no difficulty in making them.

Most of these clocks, all of which were made by M. Serviere himself, operate by the elasticity of springs, the gravity of weights, and the motion of water or of sand.

One of these clocks is represented in Plate CCCCLXXXV. Fig. 12. It consists of a dome supported by six columns on a hexagonal base. Around these columns are coiled two copper wires running in a spiral, and parallel to each other, from the dome to the pedestal. These copper wires are fixed to the columns by small consols, so as to form a channel or groove, which permits a polished copper ball to descend by its own weight from the top of the railway to the bottom. As soon as the copper ball reaches the bottom it enters a hole H, where it falls upon a spring, whose detent being loosened by the impulse, throws it up again with the utmost nicety through the hole G in the ceiling of the dome, where it again enters the copper railing, and descends as before. The ball continues this motion with the greatest regularity, performing its ascent and descent in equal times, and consequently communicating an equal motion to the clock in the pedestal below, by its successive impulses upon the spring beneath the hole H.

In another clock of the same kind, the small copper ball, in place of being projected upwards by a spring, is carried upwards in a small bucket which rises and falls perpendicularly within the columns. This little bucket receiving the ball when it quits the wire groove, delivers it into the dome at the commencement of the railway.

In a *third* clock the copper ball is carried up on the outside groove of an Archimedes's screw placed in an inclined position between the columns. In a *fourth* clock, which resembles a writing desk, a second ball makes its appearance at the top of the railway just when the first descends into its hole, and these two balls succeed each other with great accuracy.

In a *fifth* clock the copper ball passes through the bodies of two serpents, one placed above the other; the upper one having a see-saw motion round its centre. When the upper serpent stoops with its head it receives from the tail of the lower serpent a ball of copper which it swallows, and passing along to its tail, the descent of the tail delivers it into the mouth of the lower serpent. The oscillations of the upper serpent give motion to the clock in the pedestal below. This clock is shown in Plate CCCCLXXXV. Fig. 13.

In a *sixth* clock a cylindrical copper box, about five inches in diameter, with dial plate and hour hand like a watch, descends imperceptibly along an inclined plain. There is also a rectilineal dial with the hours on the edge of the inclined plane; and the index hand on the cylindrical box, which always keeps a vertical position, points out with its upper end the hour on the dial of the box, and with its lower end the hour on the rectilineal dial. This timepiece has neither spring nor counterweight. The time that it keeps going is proportional to the length of its inclined plane, and it receives its motion only by the effort which the round box makes to retain itself on the inclined plane contrary to its natural tendency downwards. The experiment with it is made thus:—when the box is on the inclined plane it descends imperceptibly and regularly, marking the time as has been mentioned, and the motion of its balance is distinctly heard; but as soon as the cylindrical box is taken from the inclined plane and placed on a horizontal plane, the motion of the clock ceases, and the sound of its balance is no longer heard, because the round figure being then in its natural state no longer makes any effort.

In a *seventh* clock the cylindrical box after completing one inclined plane comes upon a horizontal one which it elevates to the same angle as the first; and in an *eighth* clock the inclined plane forms a spiral round a little temple, the inclined plane replacing the wires in Fig. 12. and the box takes a week to descend it. When it has reached the bottom it is carried up to the top and again commences its descent.

Another clock described by M. Serviere operates by the fall of sand, which causes it to move. The flow of the sand occupies exactly one hour. Its cage has an axis round which it turns like the index of the dial of a common clock. The two glasses which hold the sand have the form of those in the common sandglass. They have each a false moveable bottom, which can rise and fall a little by the aid of a fine piece of skin which folds up and falls down like the leather of a pair of bellows. When the sand has flowed from the upper into the under glass, the false bottom of the last glass, on which all the sand rests, descends and presses up a lever balanced by a counterweight less heavy than all the sand. The beam, therefore, receives a see-saw motion at the moment when the last grains of sand fall into the lower glass, and a detent being at the same time loosened, the springs in the interior of the box act and turn round the sandglass. The empty bottle is now undermost, the sand again flows, and the same operation is repeated. Every time that the sandglass turns, the dial plate, which is within the box, makes one twelfth of a revolution, and each hour shows itself at an opening in the box.

In another clock of M. Serviere's invention, the hours marked on the horizontal cornice of a room are pointed out by the figure of a mouse which runs along the cornice, and the same effect is produced on a vertical column by the ascent and descent of a lizard.

Magnetic Clock.

The last clock of M. Serviere's invention which we shall notice, consists of a plate of tin like a soup plate, on the circumference of which the hours are engraven. After filling the plate with water, a tortoise cut out of cork is thrown into the plate, and constantly goes in quest of the hour, pointing it out with its mouth on the dial-plate. When left in that position it follows imperceptibly the margin of the plate, showing the hour with great accuracy. In whatever way the plate is turned, and wherever it is placed, the tortoise indicates the hour with equal accuracy. The construction of this piece of mechanism is not hinted at by M. Serviere, but we cannot doubt that there is placed in the inside of the plate, that is, within the thickness of its bottom, a common watch, whose hours correspond with those on the external dial, and whose hour hand is magnetised. If a piece of steel or soft iron is placed within the tortoise, it is quite clear that the magnetised hour hand will cause the tortoise to take a parallel position, and to follow it round the dial-plate, pointing out the hours with the same accuracy as the real hour hand would do were it visible.

There are a great many amusing and highly ingenious pieces of clock-work invented by Dr. Franklin, James Ferguson, and others, which might with great propriety have been described in the present article; but as most of these have been described in the works of Ferguson, which are in the hands of almost every person, it would not be adviseable to repeat the descriptions here, as our object has been to describe inventions which are not very commonly known, and which are found in works not possessed by general readers.

HYDRODYNAMICS.

In our article on HYDRODYNAMICS, we have given an account of various amusing experiments, to which it is necessary only to refer the reader.

1. *Mr. Perkins's Steam Guns.*

Mr. Perkins's steam guns.

Among the most remarkable inventions of modern times, must be enumerated the steam gun of Mr. Perkins, by which, with the elastic force of steam, he is able to discharge balls with a velocity and force which surpass even those produced by gun-powder. But it is not merely on this ground that the steam gun is superior to the ordinary one. The balls may be

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made to follow one another in immediate and rapid succession.

In order to prove the power of his gun, Mr. Perkins has constructed a small apparatus, which, when connected with the steam boiler or generator, has been found to discharge ordinary musket bullets at the rate of 240 in a minute, and with such terrible force, that after passing through an inch deal, the ball, in striking against an iron target, became flattened on one side and squeezed out. The original size of the bullets were 0.65 of an inch, but after striking the target, they were plano-convex, their diameter being 1.070 inches, and their thickness 0.29 of an inch.

When the gun is constructed for use, the balls are put into a sort of hopper, and the moment one of them falls into its place, a cock is turned, which allows a portion of the highly heated water to flash off into steam, and to propel the ball with a tremendous force. Under our article Steam, we may, perhaps, be able to give some farther information concerning this curious invention.

2. *Perkins's Steam Rocket.*

Perkins's steam rocket. Fig. 14.

This very ingenious invention, which Mr Perkins has recently secured by a patent, is shown in section in Plate CCCCLXXXV. Fig. 14. where *a b* is the rocket or hollow vessel made of wrought iron. A piece of iron *b* is screwed into the end of it, and having a small aperture or bore through it. To the piece *a* is attached the tail of the rocket, in the guide rods *c*, *c*, in place of the usual rocket stick. The hollow part of the rocket *a b* is then to be nearly filled with water, and the bore in the piece of iron *b* is to be filled up with a plug of brass, which will confine the water within under a very high pressure.

Fig. 15.

Thus prepared the rocket is now placed in a furnace, shown in Fig. 15. in which is built a cylinder *d d* of cast iron, open at both ends, and lying obliquely. The rocket being put into the cylinder, and the heat applied below, the rocket is heated to such a degree as to melt the brass plug, when the water escapes in the form of steam with tremendous force, and drives the rocket forward in the direction of the cylinder. By employing plugs of different metals, or of such alloys as melt at given temperatures, the force with which the rocket is propelled is completely under the control of the operator. This most ingenious invention is obviously applicable to the projection of all kinds of projectiles, such as shells, &c. See Newton's *Journal of the Arts*, vol. x. p. 48.

MAGNETISM.

Since our article Magnetism was published, many curious discoveries have been made in that science; but the limits as well as the nature of this article will only permit us to notice the most popular.

1. *On the Magnetism of Balls and Shells of Iron.*

On the magnetism of balls and shells of iron.

Although it has been long known that a bar of iron placed vertically or perpendicular to the magnetic equator, has in our latitudes its lower end a north pole, and its upper end a south pole, yet it was left to Mr. Barlow to determine the exact magnetic condition induced upon balls and masses of iron by the magnetic action of the earth. He found that there exists in every ball of unmagnetised iron a plane of no attraction which passes from north to south, and forms in our latitude an angle of about 19½° with the horizon or the complement of the dip of the needle. By more accurate observations made at Woolwich, he found the inclination of that plane to be 19° 24′, while the complement of the dip, as determined by an excellent dipping needle, was 19° 29½′. By means of numerous experiments, Mr. Barlow found that the deviation of the needle placed at any point of the surface of the sphere, was represented by the following formula.

$$\text{Tang. } \Delta = A \text{ Sin. } 2\lambda \text{ Cos. } l.$$

λ being the latitude, and l the longitude of the needle, or that the *tangent of the deviation is proportional to the rectangle of the sine of the double latitude, and the cosine of the longitude.*

By making the experiment at different distances, he found that the *tangents of the angles of deviation were reciprocally proportional to the cubes of the distance*, and using balls of different sizes, that the *tangents of the angles of deviation were proportional to the cubes of the diameters.* Hence he deduced the following general formula for the deviation.

$$\Delta = A \frac{D^3}{d^3} \left(\text{Sin. } 2\lambda \text{ Cos. } L. \right)$$

in which Δ is the angle of deviation, D the diameter of the ball, *d*, the distance of the needle, *l* the longitude of position, λ the latitude, and A a constant factor to be determined by experiment.

The most important and the most useful of Mr. Barlow's discoveries, is, that the attracting power of iron bodies for the magnet *resides wholly on their surface, and is independent of their mass*, provided the thickness exceed about the 20th part of an inch. Hence it followed, that hollow balls or shells, whose thickness exceeded the 20th part of an inch, had the same power as a ball of solid iron of the same size, a result which was confirmed by direct experiment.

To these curious deductions of Mr. Barlow, we shall add the following conclusions, deduced by M. Poisson, from his equations of magnetic equilibrium.

1. That though the boreal and austral fluids are distributed throughout the mass of a body magnetised by induction, yet the attractions and repulsions which it exercises externally are the same as if it were merely covered by a very thin stratum formed of the two fluids, in equal quantities, and such that their total action upon all the points within them should be equal to nothing.

2. A magnetic needle placed in the interior of a hollow sphere of soft iron, and so small as not to exert any sensible influence on the sphere, will not be subject to any magnetic action, and will consequently not be subject to any polarity from the effect of the earth's magnetism, or from that of any other magnet placed without the hollow sphere.

3. That if magnets are placed within this hollow sphere, their action on a small needle without it, joined to that of the sphere itself, as magnetised by their action, will produce a result equal to zero.

4. That the interposition of a plate of soft iron of any given thickness, but of a great extent, must be sufficient to prevent the transmission of the magnetic action.

5. That though the magnetism is not confined to the exterior surface of the hollow sphere, and though its intensity may be determined for any point of the solid shell, yet the magnitude of the three component forces produced by it (on a point without it) is

wholly independent of the thickness of the metal. See Dr. Brewster's *Journal of Science*, vol. II. p. 356.

2. *Experiments on the Magnetism of Red Hot Iron, and on the Effects of Heat on Magnets.*

The object of Mr. Barlow's experiments was to determine the relative magnetic power of different kinds of iron and steel in deflecting a magnetised needle from its natural direction. The following were the results which he obtained:

	Rel. Power.		Rel. Power.
Malleable-iron, .	100	Shear steel, soft, .	66
Cast steel, . .	74	Do. Hard, . .	53
Blistered steel, soft,	67	Blistered steel, hard,	53
Cast steel, hard, .	49	Cast iron, . .	47

As the hardest iron and steel were thus proved to have the least power over the needle, Mr. Barlow next tried to determine their relative powers when heated in a furnace, and while each of the different specimens were rendered soft. The results which he obtained on this point were not so uniform as the preceding, but they were very remarkable. The *malleable iron which had by far the greatest power when cold, had the least of any when heated,* and the *cast iron,* which had the *least power when cold,* had the *greatest power when hot,* the increase of power in the latter case being nearly as 3 to 1.

When the iron passed from the state of *white heat,* where every kind of magnetic action disappears, to the state of blood red heat, where the magnetic action is strongly developed, there was an intermediate action; when the iron passed through the shades of bright red and red, which attracted the needle the contrary way to what it did when cold, or at the blood red heat; that is, if the iron and compass are so placed that the north end of the needle is attracted towards the iron when cold, the south end will be attracted when the iron is red hot, and *vice versa;* but as the red changes to the darkest shades of blood red, the usual power of the iron commences, and the needle is attracted the contrary way. In addition to this, the *negative action is less in those positions where the natural cold attraction is the greatest, and greatest where the latter is the least,* and greatest of all in that position where *the cold attraction is zero;* that is, in the plane of no attraction, provided the needle is sufficiently near the bar. The bars which Mr. Barlow employed, were 25 inches long and 1¼ inch square, and were inclined in the direction of the dipping needle, the distances varying from 5 to 9 inches; but the nearer to the bar the more obvious were the effects. The quantity of negative attraction sometimes exceeded 50°.

Mr. Christie of Woolwich has extended his inquiries to the action of heat on magnets, and in a very able paper on the subject, which is printed in the Philosophical Transactions for 1824, he has given the following general results.

1. That from 3° of Fahrenheit, and even much lower, up to 127°, the intensity of the magnets decreased as the temperature increased.

2. With a certain increase of temperature, the decrease in the strength of the magnets is not the same at all temperatures, but increases as the temperature increases.

3. From a temperature of about 80°, the intensity decreases very rapidly as the temperature increases, so that if up to this temperature the differences of the decrements are nearly constant, beyond that temperature the differences of the decrements also increase.

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4. Beyond the temperature of 100° a portion of the power of the magnet is permanently destroyed.

5. When any change of temperature takes place in a magnet, the greatest portion of the effect on the strength of the magnet is produced instantaneously, which shows that the magnetic power resides in or very near the surface.

6. The effects produced on unpolarised iron by changes of temperature are directly the reverse of those produced on a magnet, an increase of temperature causing an increase in the magnetic power of the iron, the limits between which Mr. Christie observed to be 50° and 100°.

3. *On the effects of rotation on Magnets and other bodies.*

On the effects of rotation on magnets and other bodies.

One of the most curious discoveries that has been recently made in magnetism, relates to the influence of rotation on the magnetic forces. This curious property was discovered by Mr. Christie, who found that a plate of iron made to revolve round an axis passing through its centre, acquires, during its rapid rotation, and possesses, while at perfect rest, a power of producing a deviation in the magnetic needle. The extent of the deviation during rotation, was to the extent after rotation as 3 to 2, and in the same direction. Mr. Christie considers the effects which he observed as nearly independent of the velocity of rotation; a single revolution of the plate, or even less, being sufficient to produce the whole effect. Mr. Christie supposes that all the phenomena which he observed may be explained on the supposition that the mass of revolving iron acts from its centre, and that the rotation polarises it in a direction at right angles to the dip.

This curious subject was taken up by Mr. Barlow, who fixed a 13 inch mortar-shell to the mandril of a powerful turning lathe, wrought by a steam engine, and caused it to perform 840 revolutions in a minute. The magnetic needle deviated several degrees from the magnetic meridian, and remained stationary during the motion of the shell. When the motion of the shell was inverted, an equal and opposite deviation of the needle took place, but the needle always remained stationary during the motion of the shell. When the action of the earth on the needle was neutralised, so that the needle obeyed no other force but that of the magnetism of the revolving ball, and when the needle was made a tangent to the ball, its *north end* was *attracted* to the ball when the motion of the ball was *towards* the needle, and *repelled* when the motion of the ball was *from* the needle. No effect was observed in the two extremities of the axis, but the deviation was a maximum, and towards the centre of the ball, in two opposite points, at right angles to the axis. From these facts, and from the non-coincidence of the magnetic axis with the earth's axis, Mr. Barlow is disposed to think that the earth's magnetism is of the induced kind.

Long after Mr. Christie had discovered the effect of rotation in developing magnetism in iron disks,* M. Arago discovered that plates of copper and other substances, put into rapid rotation beneath a magnetised needle, caused it to deviate from its direction, and finally dragged it round with them. This experiment

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* Mr. Christie's discovery was, we believe, made so long ago as 1821 or 1822, M. Arago's in 1824, or the beginning of 1825.

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was repeated this summer, (1825) by Mr. Babbage and Mr. Herschel, who obtained many new and interesting results. They mounted a powerful compound horse-shoe magnet, capable of lifting 20 lbs. so as to receive a rapid rotation round its axis of symmetry placed vertically, the lines joining the poles being placed horizontal, and the poles upwards. A circular disc of copper, 6 inches in diameter, and one-twentieth of an inch thick, was suspended centrally over it by a silk fibre, without torsion, just capable of supporting it. A sheet of paper, properly stretched, was interposed, and no sooner was the magnet set in rotation, than the copper disc began to revolve in the same direction, slowly at first, but with a velocity gradually and steadily increasing. When the motion of the magnet was reversed, the velocity of the copper was gradually destroyed. It rested for an instant, and immediately began to revolve in the opposite direction, and so on alternately, as often as was wished. When discs of wood, antimony, zinc, bismuth, copper, lead, tin, and glass were interposed between the magnet and the copper disc, they did not intercept the magnetic virtue, a revolution being performed nearly in the same time as before; when iron was interposed, the effect was very different, the magnetic influence being greatly diminished by one, and almost annihilated by two thicknesses of common tinned iron plate. When the plates and the revolving magnets were connected by a piece of soft iron, the rotation of the copper disc was in like manner almost annihilated.

Mr. Babbage and Mr. Herschel now caused to revolve on their axes plates of copper, &c. ten inches in diameter, and half an inch thick, with a velocity of seven turns in a second. Above these plates was placed an azimuth compass, and the deviations which were produced in it by different metals, were observed as follows:

	Deviation.	Ratio of the Force to that of Copper.
Copper .	28° 54′ .	1.00
Zinc, .	26 42 .	0.93
Tin, .	12 54 .	0.46
Lead, .	7 0 .	0.25
Antimony, .	2 27 .	0.09
Bismuth, .	0 32 .	0·02

Among the other metals tried, *silver* held a high rank; and *fluid mercury* ranked between *antimony* and *bismuth.*

Mr. Babbage and Mr. Herschel are of opinion, that in all the phenomena of rotation, the magnetic virtue is induced by the action of the magnetic bar, compass needle, &c.; and that in Mr. Barlow's experiments, the earth is the inducing magnet; the rationale of the phenomena, therefore, they consider to depend on the principle, *that in the induction of magnetism, time enters as an essential element*, and that no finite degree of magnetic polarity can *be communicated to, or taken from any body whatever, susceptible of magnetism, in an instant.* By the application of this principle, and without calling in the aid of any additional hypothesis or new doctrine in magnetism, they have given a most plausible and ingenious explanation of most, if not all, the phenomena produced by rotation.

In a set of experiments made subsequently to the preceding, Mr. Christie confirmed the results obtained by Mr. Babbage and Mr. Herschel. When a thick copper plate revolved beneath a small magnet, he found that the force which caused the needle to deviate, varied directly as the velocity, and inversely as the fourth power of the distance; a law which would arise from the magnetism in the needle developing the magnetism in the particles of copper, so that its intensity should vary inversely as the square of the distance, and this magnetism again acting on the poles of the needles with a force varying as the square of the distance.

From this result, and from some others obtained by Mr. Christie, the opinion of Mr. Babbage and Mr. Herschel seems to be placed beyond a doubt, that the magnetism is induced on the copper from the needle itself. See the *Philosophical Transactions* for 1825, for the original memoirs in which the preceding discoveries are published. Abstracts of all the papers will be found in Dr. Brewster's *Journal of Science*, No. IV. V. VI. and VII.

4. *On the formation of Magnets by Percussion.*

The formation of magnets by percussion we owe to the ingenuity of Captain Scoresby. In the interesting experiments which he has published on this subject, he found that in soft iron, percussion generated a strong, but evanescent magnetism; whereas, in soft steel, the greatest degree of magnetic energy could be developed by percussion. In order to produce this effect, he hammered a bar of soft steel six and a half inches by one quarter of an inch in diameter, and weighing 392 grains, held in a vertical position, with its lower end resting on any metal, or even on stone, and after 17 blows, it lifted six and a half grains. The magnetic effect was amazingly increased when the lower end of the steel bar rested on the upper end of a large rod of iron or soft steel; the preceding bar, which lifted only 6½ grains by the first process, now lifting eighty-eight grains after twenty-two blows. When the poker, or a large rod of iron, had been itself previously hammered in a vertical position, a single blow gave a lifting power of twenty grains, and in one instance ten blows produced a lifting power of 188 grains, which was nearly one-third of its own weight. Mr. Scoresby has subsequently improved this process, by hammering the steel bars between *two bars of iron*. In this case the steel bar which lifted 186 grains by the first process, now lifted 826 grains; and when the new process was employed with an iron bar eight feet long, the same wire lifted 669 grains, or four times its own weight. When magnetised iron and steel are hammered in the magnetic equator, or nearly in a horizontal position, their magnetism is destroyed by a few blows.

Mr. Scoresby's theory of this process is, that percussion on magnetiseable substances in mutual contact disposes them to assume an equality of condition, in the same manner as bodies of different temperatures assume the same temperature by juxta-position. As the two large iron bars are magnetical by position, the bar of steel, hammered between them, will, when thus thrown into a state of vibration, receive a share of their magnetism. For particular details respecting Captain Scoresby's experiments, see the *Edinburgh Transactions*, vol. ix. p. 243, 353, and *Philosophical Transactions*, vol. xxii. p. 241.

For an account of Mr. Barlow's Correcting Plate, see the article VARIATION *of the Needle.*

MECHANICS.

1. *Kempelen's Chess Automaton.*

Among the curiosities of mechanical science we may, without hesitation, rank the chess automaton of Kempelen. In our Article **Androides**, vol. ii. p. 65, we have already given a full account of that interesting piece of mechanism, and have pointed out the probability that a person of small size was confined within the machine. This view of the subject has been almost demonstrated in a very ingenious little work, published in London in 1821, and entitled an *Attempt to Analyse the Automaton Chess Player of M. De Kempelen,* which was written in consequence of the reappearance of the Automaton in Great Britain in 1820. The following extracts from this work will exhibit the principal arguments which it contains.

"The annexed drawings, (Plate CCCCLXXXV. Figs. 16. and 17.) represent the general appearance of the machine. It runs on castors, and is either seen on the floor when the doors of the apartment are thrown open, or is wheeled into the room at the commencement of the exhibition.

The exhibitor, in order to show the mechanism, as he informs the spectators, unlocks the door (A, Fig. 16.) of the chest, which exposes to view a small cupboard, lined with black or dark-coloured cloth, and containing different pieces of machinery, which seem to occupy the whole space. He next opens the door (B, Fig. 17.) at the back of the same cupboard, and holding a lighted candle at the opening, still farther exposes the machinery within. The candle being withdrawn, the door (B) is then locked. The drawer (G, G, Fig. 16.) in the front of the chest is then opened, and a set of chess men, a small box of counters, and a cushion for the support of the Automaton's arm, are taken out of it. The exhibitor now opens the two front doors (C C, Fig 16.) of the large cupboard, and the back door (D, Fig. 17.) of the same, and applies a candle, as in the former case. This cupboard is lined with cloth like the other, but it contains only a few pieces of machinery. The chest is now wheeled round, the garments of the figure lifted up, and the door (E, Fig. 17.) in the trunk, and another (F) in the thigh, are opened. But it must be observed, that the doors (B and D) are closed.

The chest is now restored to its former position on the floor; the doors in front, and the drawer, are closed and locked; and the exhibitor, after he has occupied some time at the back of the chest, in apparently adjusting the machinery, removes the pipe from the hand of the figure, winds up the works, and the Automaton begins to move."

The author then proceeds to point out a method by which a person well skilled in the game, and not exceeding the ordinary stature, may secretly animate the automaton, and imitate the movements of the chess-player. This method will be easily understood from the following extract:

"The drawer (G G, Fig. 25.) when closed, does not reach to the back of the chest; it leaves a space (O) behind it, about 1 foot 2 inches broad, 8 inches high, and 3 feet 11 inches long. This space is never exposed to view.

The small cupboard is divided into two parts by the door or screen (I, Fig. 21.) which is moveable on a hinge, and is so contrived that when B is closed, this screen may be closed also. The machinery (H) occupies the whole of the front division as far as I; the hinder division is nearly empty, and communicates with the space behind the drawer, the floor of this division being removed.

"The back of the great cupboard is double, and the part (P, Q) to which the quadrants, &c. are attached, moves on a joint (Q), at the upper part, and forms, when raised, an opening (S) between the two cupboards, by carrying with it part of the partition (R), which is composed of cloth stretched tight. Fig. 25. shows the false back closed. Fig. 26. shows the same raised, forming the opening (S) between the chambers.

When the trunk of the figure is exposed by lifting up the dress, it will be seen that a great part of it is occupied by an inner trunk (N), which passes off towards the back in the form of an arch, (Fig. 17.) and conceals a portion of the interior from the view of the spectators. This inner trunk opens to the chest by an aperture (T, Fig. 24.) about 1 foot 8 inches high, by 1 foot broad.

When the false back is raised, the two chambers, the trunk, and the space behind the drawer, are all connected together.

The player may be introduced into the chest through the sliding pannel (U, Fig. 21.) at the end. He will then elevate the false back of the large cupboard, and assume the position represented by the dotted lines in Figs. 18 and 19. Every thing being thus prepared, 'the charm's wound up,' and the exhibitor may begin his operations by opening the door (A.) From the crowded and very ingenious disposition of the machinery in this cupboard, the eye is unable to penetrate far beyond the opening, and the spectator is led to conclude that the whole space is occupied with a similar apparatus. This illusion is strengthened and confirmed by observing the glimmering light which plays among the intricacies of the machinery, and occasionally meets the eye, when the lighted candle is held at the door (B). A fact, too, is ascertained, which is equally satisfactory, though for opposite reasons, to the spectator and the exhibitor, viz. that no opake body of any magnitude is interposed between the light and the spectator's eye. The door (B) must now be locked, and the screen (I) closed, which being done at the moment the light is withdrawn, will wholly escape observation.

It has been already mentioned, that the door (B), from its construction, closes by its own weight; but as the player's head will presently be very near it, the secret would be endangered, if, in turning round the chest, this door were, by any accident, to fly open; it becomes necessary, therefore, "to make assurance double sure," and turn the key. If the circumstance should be observed, it will probably be considered as accidental, the keys being immediately wanted for the other locks.

The opening (B) being once secured, and the screen (I) closed, the success of the experiment may be deemed complete. The secret is no longer exposed to hazard; and the exhibitor is at liberty to shape his conduct in any way he may think most likely to secure the confidence of the spectators, and lead them insensibly from the main object of pursuit. The door (A) may safely be left open; this will tend to confirm the opinion, which the spectators probably formed on viewing the candle through this cupboard, that no person was concealed within it: it will further assure them that nothing can pass the interior without their knowledge, so long as this door continues open.

The drawer stands next in the order of succession: it is opened, *generally,* for the purpose of taking out the chess men, cushion, &c. but *really* to allow time

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for the player to change his position, (see Fig. 20.) and to replace the false back and partition, preparatory to the opening of the great cupboard.

The machinery is so thinly scattered over this cupboard, that the eye surveys the whole space at one glance, and it might seem necessary to open a door at the back, and to hold a lighted candle there, as an instance; but the artifice is dictated by sound policy, which teaches that the exhibitor cannot be too assiduous in affording facilities to explore every corner and recess, which, he well knows, contains nothing that he is desirous of concealing.

The chest may now be wheeled round for the purpose of showing the trunk of the figure; leaving, however, the front doors of the great chamber open. The bunch of keys, too, should be suffered to remain in the door (D); for the apparent carelessness of such a proceeding will serve to allay any suspicion which the circumstance of locking the door (B) might have excited, more especially as the two doors resemble one another in point of construction.

When the drapery has been lifted up, and the doors in the trunk and thigh opened, the chest may be returned to its former situation, and the doors be closed. In the mean time the player should withdraw his legs from behind the drawer, as he will not so easily effect this movement after the drawer has been pushed in.

Here let us pause a while, and compare the real state of the chest at this time, with the impression which, at a similar period of an exhibition of the Chess Player, has generally been left on the minds of the spectators; the bulk of whom have concluded that each part of the chest had been successively exposed; and that the whole was at that time open to inspection: whereas, on the contrary, it is evident that some parts had been entirely withheld from view, others but obscurely shown, and that nearly half of the chest was then excluded from their sight. Hence we learn how easily, in matters of this sort, the judgment may be led astray by an artful combination of circumstances, each assisting the other towards the attainment of one object.

When the doors in front have been closed, the exhibitor may occupy as much time as he finds necessary, in apparently adjusting the machinery at the back, whilst the player is taking the position described in Figs. 22. and 23. In this position he will find no difficulty in executing every movement required of the automaton: his head being above the table, he will see the chess-board through the waistcoat as easily as through a veil; and his left hand extending beyond the elbow of the figure, he will be enabled to guide its hand to any part of the board, and to take up and let go a chess man with no other "delicate mechanism" than a string communicating with the finger. His right hand being within the chest, may serve to keep in motion the contrivance for producing the noise, which is heard during the moves, and to perform the other tricks of moving the head, tapping on the chest, &c.

"In order to facilitate the introduction of the player's left arm into the arm of the figure, the latter is obliged to be drawn backwards; and to account for, and conceal this strained attitude, a pipe is ingeniously placed in the automaton's hand. This pipe must not be removed till the other arrangements are completed.

"When all is ready, and the pipe removed, the exhibitor may turn round the winder, to give the impression to the spectators of winding up a spring, or weight, and to serve as a signal to the player to set the head of the automaton in motion.

The above process is simple, feasible, and effective; showing indisputably that the phenomena may be produced without the aid of machinery, and thereby rendering it probable that the Chess Player derives its merit solely from the very ingenious mode by which the concealment of a living agent is effected.

Explanation of Plate CCCCLXXXV. Fig. 16—26.

Fig. 16. A perspective view of the Automaton, seen in front, with all the doors thrown open. Fig. 17. An elevation of the back of the Automaton. Fig. 18. An elevation of the front of the chest, the dotted lines representing the player in the first position. Fig. 19. A side elevation, showing the player in the same position. Fig. 20. A front elevation, showing the second position. Fig. 21. An horizontal section through the line WW, Fig. 20. Fig. 22. A front elevation, showing the third position. Fig. 23. A side elevation of the same position. Fig. 24. A vertical section through the line XX, Fig. 23. Fig. 25. A vertical section through the line YY, Fig. 22, showing the false back closed. Fig. 26. A similar section, showing the false back raised.

The following Letters of Reference are employed in all the Figures from 16 to 26.

A, Front door of the small cupboard. B, Back door of ditto. CC, Front doors of large cupboard. D, Back door of ditto. E, Door of ditto. F, Door in the thigh. GG, The drawer. H, Machinery in front of the small cupboard. I, Screen behind the machinery. K, Opening caused by the removal of part of the floor of the small cupboard. L, A box which serves to conceal an opening in the floor of the large cupboard, made to facilitate the first position; and which also serves as a seat for the third position. M, A similar box to receive the toes of the player in the first position. N, The inner chest, filling up part of the trunk. O, The space behind the drawer. PQ, The false back turning to the joint at Q. R, Part of the partition formed of cloth stretched tight, which is carried up by the false back, to form the opening between the chambers. S, The opening between the chambers. T, The opening connecting the trunk and chest, which is partly concealed by the false back. U, Panel which is slipped aside to admit the player."

2. *On the Process of Cutting Steel with Soft Iron.*

It has for a long time been the practice of the Shakers in America to cut the hardest steel with a revolving wheel of the softest iron. The experiment was successfully tried by Mr. Barnes in America, and also by Mr. Perkins in London. Mr. Barnes made a circular plate of soft sheet iron, with which he cut a file into two, without its being in the least degree impressed by the file. During the operation of cutting a steel saw plate, there appeared a band of intense fire round the soft iron which continually emitted sparks with great violence. He afterwards cut out the saw teeth by the same means.

Some persons have supposed that this remarkable result arises from the iron making the steel red hot before it is cut, so that the process is nothing more than a peculiar method of cutting steel when rendered soft by heat. This, however, does not seem to be a correct view of the matter; as appears from a careful investigation of the process by M. M. Darien and Colladon of Geneva. These gentlemen observed that the iron wheel was covered with small fragments of the steel, and that these fragments were as hard as the best tempered steel, which proved that it could not have been softened by heat. They found also that, with a velocity of thirty-four feet per second an iron wheel was easily cut with a steel graver without any reaction on the graver. With a velocity of thirty-four feet nine inches, the iron was less attacked, and the graver began to experience an impression from the iron. With a velocity of thirty-five feet one inch, the action of the iron on the graver was decided, and increased with greater velocities, till, at a velocity of seventy feet per second, the iron was no longer marked by the steel, while the steel was cut with the greatest violence. M. M. Darien and Colladon are of opinion that the whole effect is directly mechanical, arising from the brittleness of the steel, which is torn asunder before it has time to introduce itself among the particles of the soft iron, a phenomenon which they consider as analogous to the penetration of wood by a ball of tallow discharged from a gun.

When a wheel of pure copper was used, no effect was produced upon the graver; but what was very remarkable, *little or no heat was generated when files and steel springs were held firmly against the revolving copper wheel.* See the *Bibl. Universelle,* April 1824, p. 283—290, or an abstract of the Memoir in Dr. Brewster's *Journal of Science,* Vol. I. p. 341, October 1824.

3. *Description of Dr. Black's simple and delicate Balance.*

The description of this very simple and accurate balance has been recently published by James Smithison, Esq. to whom it was communicated in a letter from Dr. Black himself. The beam of the balance was a piece of fir wood, of the thickness of a shilling, about a foot long, three tenths of an inch broad in the middle, and 1½ tenth at each end. This beam is divided by transverse lines into 20 parts, or 10 parts on each side of the middle. Each of these is divided into halves or quarters. Across the middle of the beam is fixed with sealing wax one of the smallest needles that could be procured, to serve as a horizontal axis. A piece of plate brass has its two ends bent up, so as to form three sides of a cube, and on the two edges of this piece of brass, ground on a flat hone, the needle rests as on a fulcrum. These edges are only 1½ or 2-10ths of an inch above the table, so that the beam has very little play.

The weights which Dr. Black used were one globule of gold, which weighed one grain, and two or three others which weighed one tenth of a grain each. He used also a number of small rings of fine brass wire, made by coiling it round a thicker brass wire in a close spiral. The extremity of the spiral being tied hard with a waxed thread, the covered wire was put into a vice, and a sharp knife being applied, and struck with a hammer, a great number of the coils were cut through at one stroke, and they were as exactly equal to each other as could be desired. Those which Dr. Black used happened to be one-thirtieth of a grain each. By means of these weights placed at different distances from the middle of the beam, he could weigh any little mass from one grain, or a little more, to the twelve-hundredth part of a grain. See the *Annals of Philosophy,* N. S. Vol. X. p. 52.

Science, Curiosities in.

4. *Description of a Chinese Mangle.*

Description of a Chinese mangle. PLATE CCCCLXXXV. Fig. 27, 28.

This very ingenious and simple piece of mechanism is represented in Plate CCCCLXXXV. Fig. 27, 28, which is taken from a model of it executed by Andrew Waddel, Esq. of Hermitage Hill, a few days after he had seen it at work in Canton in 1786. Fig 27 shows the stone or mangle at rest, standing on its end on the floor, with the roller and cloths coiled round it previous to the commencement of the operation. The house was paved with tiles, as shown at A, and on the floor was a concavity B, lined apparently with hard wood. The roller C, with the cloth wrapped round it, was laid in the concavity B. The weight on which the whole operation depended was a stone D, apparently sandstone, weighing from 10 to 12 cwt. and shaped so as to stand on either end, as the workman chooses, when he wishes to examine his work, or when he finishes it. By resting on the framing of bamboos E, E, E, he steps on the uppermost end of the stone D, and allows its under surface to fall gently on the roller C. He is now in the position shown in Fig. 28, when he presses alternately with each foot so as to give the stone an alternate motion, which causes the roller C, with the cloth, to pass over the whole concavity B of the floor, and with the degree of velocity which he chooses.

Since Mr. Waddell communicated to the writer of this article the preceding drawing and description, we have obtained possession of a Chinese drawing of the same apparatus, in a series of paper hangings for rooms. We have given an exact copy of it in Fig. 29.

5. *Mr. Babbage's Calculating Machinery.*

Mr. Babbage's calculating machinery.

Although pieces of mechanism for performing particular arithmetical operations have been long ago constructed, yet all these sink into insignificance when compared with the extraordinary machinery recently invented by Mr. Babbage. As no description of this machinery has yet been published, we are of course not able to convey any idea of it to the reader; but the effects which it is capable of producing are so wonderful, that a general notice of them cannot fail to be acceptable.

Mr. Babbage's first object was to produce printed copies of any mathematical tables, *without the possibility of an error existing in a single copy.* Although this was to be effected by machinery, yet certain preliminary calculations were necessary, and the machinery required to be set to these numbers at intervals; but in some cases, when it is once set, the machinery will continue working to the end of the tables.

In order to demonstrate the practicability of his machinery, Mr. Babbage has constructed a small engine, by which the following table was computed from the formula, x^2+x+41.

41	131	383	797	1373
43	151	421	853	1447
47	173	461	911	1523
53	197	503	971	1601
61	223	547	1033	1681
71	251	593	1097	1763
83	281	641	1163	1847
97	313	641	1231	1933
113	347	743	1301	2021

These numbers, as soon as they were calculated, sion of the conversion of a cameo into an intaglio, and of an intaglio into a cameo, by an inverting eye-piece, is the result of an operation of our own minds, whereby we judge of the forms of bodies by the knowledge we have acquired of light and shadow. The greater our knowledge therefore, is, of this subject, the more readily does the illusion seize upon us; while, if we are but imperfectly acquainted with the effects of light and shadow, the more difficult is it to be deceived. If the hollow is not polished, but ground, and the surface round it of uniform colour and smoothness, almost every person, whether young or old, will be subject to the illusion; but if the object is the raised impression of a seal upon wax, we have often found that, when viewed with the eye-piece, it still seemed raised to the three youngest of six persons, while the three eldest were subject to the deception. By such trifling and often unappreciable circumstances is our judgment affected, that the same person at one moment sees the convexity raised, and at another time depressed, though viewed as nearly as possible and under the same circumstances. This remarkable effect no doubt arises from the introduction of some casual reflected lights, which the slightest change of position will produce.

Having thus seen how our judgment concerning elevations and depressions is affected by our degree of knowledge of the effects of light and shade, and by unappreciable causes, we shall proceed to consider how our judgment is affected by the introduction of new circumstances.

Fig. 8.

Let the depression A, illuminated by one candle, as in Fig 6, be converted into an elevation as in *Fig.* 7, by the application of an inverting eye-piece; then, if another candle C′, Fig. 8, is introduced so as to illuminate the depression A in the same manner, and with nearly the same intensity as C does, the elevation will fall down into a depression. The cause of this is obvious: the application of the inverting eye-piece produces no effect whatever, for both the sides of the cavity are symmetrically illuminated. In moving round the second candle C′ from its position C′, so as to stand beside C, it is curious to observe the progress of the deception by which the depression is again changed into an elevation.

Fig. 9.

Fig. 10.

If when the depression A, *Fig.* 9, is converted into an elevation, we introduce a small unpolished opaque body M, and place it either beside the hollow or in it, so that the body M, and its shadow *m*, may be distinctly seen by the microscope, we shall have the appearance shown in Fig. 10, the elevation having sunk into a depression. This correction of the deception arises from the introduction of a new illusion, namely, that which arises from the shadow *m*, for it is evident that as the body M appears to project its shadow in the direction M *m*, the luminous body must be supposed to be on the same side; and the evidence that this is the case, is more powerful than our knowledge that the candle is actually at C, because it co-exists along with our perception of the depression A, whereas our knowledge of the situation of the candle is an act of recollection.

Fig. 11.

Fig. 12.

This correction of the delusion may be effected in another manner, which is perhaps more complete. If, in place of the unpolished body, we use a pin with a highly polished head, as shown at M, *Fig.* 11, and then apply the inverting eye-piece, we shall have the effect shown in Fig. 12, the cavity A appearing depressed. The image *s* of the candle C being seen by reflection in the polished head of the pin M, is seen by the application of the eye-piece at *s*, on the right hand side of M in Fig. 12, so that we immediately conceive, in opposition to our previous knowledge, that the candle must be at D; and hence the elevation falls into a depression the moment the pin head is pushed up into the field of view. The shadow M *m* has also its influence in the present case.

The next case in which this illusion is dispelled, is, when the sense of touch corrects the deduction formed through the medium of sight. Let the cavity A be raised into an elevation by the inverting eye-piece, as in Fig. 7. Then if the cavity is sufficiently deep, and if we place the point of our finger in the cavity, the evidence which this gives us of its being a depression, is superior to the evidence of its being a cavity arising from the inversion of the shadow; the apparent elevation will of course sink into a depression; but the moment the finger is withdrawn, it will again rise into an elevation.

Fig. 13.

Having thus considered some of the principal phenomena arising from the inversion of the object, we shall now proceed to explain some analogous facts which are owing to the transparency of the cavities. If M N, Fig. 13, for example, is a plate of mother-of-pearl, and A a cavity ground or turned in it; then if this cavity is illuminated by a candle C, or by a window at C, in place of there being a shadow at the side *s*, as there would have been had the body been opaque, there is a quantity of refracted light seen along the whole side *s*, next the candle. The consequence of this is, that the cavity appears as an elevation when seen only by the naked eye, as it is only an elevated surface that could have the side *s* illuminated. The fact which we have now stated, is, we think, a very important one in so far as it may affect the labours of the sculptor. In some kinds of marble, the transparency is so great, that the depressions and elevations in the human face cannot be represented by it with any degree of accuracy; and, consequently, transparent marble ought never to be used for works of any importance.

Fig. 14.

Illusions arising from the same cause may be observed even when the surface of the body is perfectly plain and smooth. If M N, Fig. 14 is the surface of a mahogany table, M N *n m* a section of it, and *a b c* a section of a knot in the wood, then it often happens from the transparency of the thin edge at *a*, next the candle, that that side is illuminated while the opposite side at *c* is dark, the eye being placed in the plane of the section *a b c*. The consequence of this is, that the spot *a b c* appears to be a hollow in the table.

From hence arises the appearance in certain plates of agate, which has obtained for it the name of hammered agate. The surface on which these cavities appear is a section of small spherical aggregations of siliceous matter like *a b c* in Fig. 14, which present exactly the same phenomenon, arising from the same cause as the knots in mahogany and other woods.

The very same phenomenon is often seen in mother-of-pearl. Indeed it is so common in this substance, that it is almost impossible to find a mother-of-pearl counter which seems to have its surfaces flat, although they are perfectly so when examined by the touch. Owing to the refraction of the light by the different growths of the shell lying in different planes, the flattest surface seems to be unequal and undulating.

One of the finest deceptions which we have ever met with, arising from the disposition of light and shadow, presented itself on viewing through a telescope the surface of a growing field of corn, illuminated by the sun when near the horizon. The field was about two miles distant, and was divided into furrows, which were directed to the eye of the observer as shown in Fig. 15, Plate CCCCLXXXVI, where A B, C D, EF, represent these furrows. These furrows are of course depressed, and the growing corn rises gradually from two adjacent ones towards the middle *m n*, *o p*, so that the surfaces A *m* C, C *o* E were convex. The drills of corn on the highest summits *m n*, *o p*, caught the rays of the setting sun, which shone upon them very obliquely in the direction S *s*, and illuminated the summits laterally, while the furrows A B, C D, E F, were in shadow. The consequence of this disposition of the light and shade was, that the whole field seemed to be trenched, and the corn to be growing in the trenches as well as upon the elevated beds between them. The half furrow A B *n m* being shaded on its edge A B, and illuminated on its edge *m n*, became the elevated part of the trenched ground, while the other half *m n* C D appeared the sunk part, in consequence of the side *m n* being illuminated, and its other side C D in shade. At a certain period of the day, this illusion did not take place, and it was dispelled the moment the sun had set. This very singular illusion I have seen on several days in July. The telescope had no effect whatever in producing it, as it showed objects erect.

An illusion of an analogous nature I once observed when looking at the abbey church of Paisley, where the clustered columns of a Gothic pillar all sunk into hollow flutings. The cause of this deception I could not at the time discover, but it must have arisen from some mistaken notion respecting the direction in which the object was illuminated.

The last species of illusion of this nature, and perhaps the most remarkable of all of them, may be produced by a continued effort of the mind to deceive itself. If we take one of the intaglio moulds used for making the bas-reliefs of that able artist Mr. Henning, and direct the eye to it steadily without noticing surrounding objects, we may coax ourselves into the belief that the intaglio is actually a bas-relief. It is difficult at first to produce the deception, but a little practice never fails to accomplish it.

I have succeeded even in carrying this deception so far as to be able, by the eye alone, to raise a complete hollow mask of the human face into a raised head. In order to do this, we must exclude the vision of other objects; and also the margin or thickness of the cast. This experiment cannot fail to produce a very great degree of surprise in those who succeed in it; and it will no doubt be regarded by the sculptor who can use it as a great auxiliary in his art. See Dr. Brewster's *Journal of Science*, No. VII.

the in-bility of ain co-s to ain eyes.

4. *On the invisibility of certain colours to certain eyes.*

Several cases have been recorded in the *Philosophical Transactions* where persons with sound eyes, capable of performing all their ordinary functions, were incapable of distinguishing certain colours, and what is still more remarkable, this imperfection runs in particular families. Mr. Huddart mentions the case of one Harris who could only distinguish black and white, and he had two brothers almost equally defective, one of whom always mistook orange for green. Another case is recorded in the *Philosophical Transactions* in which full reds and full greens appeared alike, while yellows and dark blues were very easily distinguished. Our celebrated chemist Mr. Dalton cannot distinguish blue from pink by daylight; and in the solar spectrum the red is scarcely visible, the rest of it appearing to consist of two colours, yellow and blue. Dr. Butters, in a letter addressed to the editor of this work, has described the case of Mr. R. Tucker, son of Dr. Tucker of Ashburton, who mistakes orange for green, like one of the Harrises. Like Mr. Dalton he could not distinguish blue from pink; but he always knew yellow. The colours in the spectrum he describes as follows:

1. Red mistaken for . . brown,
2. Orange . . . . . green,
3. Yellow, generally known, but sometimes taken for . . orange,
4. Green mistaken for . . . orange,
5. Blue . . . . . pink,
6. Indigo . . . . purple,
7. Violet . . . . purple.

Mr. Harvey has described, in a paper read before the Royal Society of Edinburgh, the case of a person now alive, and aged 60, who could distinguish with certainty only white, yellow and grey. He could, however, distinguish blues when they were light. Dr. Nichols mentions a case where a person who was in the navy purchased a blue uniform coat and waist-coat, with *red* breeches to match the *blue*, and he has mentioned one case in which the imperfection is derived through the father, and another in which it descended from the mother.

In the case of a young man in the prime of life, with whom the writer of the article is acquainted, only two colours were perceived in Dr. Wollaston's spectrum of five colours, viz. red, green, blue and violet. The colours which he saw were *blue* and *orange*, or *yellow*, as he did not distinguish these two from one another. When all the colours of the spectrum were absorbed by a reddish glass, excepting *red* and *dark green*, he saw only one colour, viz. yellow or orange. When the middle of the red space was absorbed by a blue glass, he saw the black line with the yellow on each side of it. We are acquainted with another gentleman who has a similar imperfection.

In all the preceding cases, there is one general fact, that *red light*, and colours in which it forms an ingredient, are not distinguishable by those who possess the peculiarity in question. Mr. Dalton thinks it probable that the red light is, in these cases, absorbed by the vitreous humour having a blue colour; but as this is a mere conjecture, which is not confirmed by the most minute examination of the eye, we cannot hold it as an explanation of the phenomena. Dr. Young thinks it much more simple to suppose the absence or paralysis of these fibres of the retina which are calculated to perceive red, while Dr. Brewster conceives that the eye is in these cases insensible to the colours at one end of the spectrum, just as the ear of certain persons has been proved, by Dr. Wollaston, to be insensible to sounds at one extremity of the scale of musical notes, while it is perfectly sensible to all other sounds.

If we suppose, what we think will ultimately be demonstrated, that the choroid coat is essential to vision, we may ascribe the loss of red light in certain eyes to the retina itself having a blue tint. If this should be the case, the light which falls upon the choroid coat will be deprived of its red rays, by the absorptive power of the blue retina, and consequently the impression convey-were exhibited to the eye on two opposite sides of the machine, to the persons employed to copy them. In the early numbers of the table the copyist rather more than kept pace with the engine; but when five figures were required, the machine was at least equal in speed to the writer. At another experiment with it, thirty-two numbers were calculated in two minutes and thirty seconds, and as these contained eighty-two figures, the engine produced thirty-three figures every minute. At another time it produced forty-four figures in a minute.

Although this machine contains many wheels, yet the same parts are frequently repeated, and only a few wheels move at the same time. Notwithstanding the number of the wheels employed, yet, by a peculiar contrivance, any error produced by accident, or by any slight inaccuracy in one of the wheels, is corrected as soon as it is transmitted to the next.

Mr. Babbage has constructed a working model of the machine for composing with types. When put up, it will contain about 30,000 types, which are set in their places by children, but the person who attends the engine has a method of ascertaining, in less than 30 minutes, whether or not any one individual type of the number is misplaced.

During the progressive improvement of the machinery, Mr. Babbage was led to a new arrangement, by which an engine might be constructed which should calculate tables of other species whose analytical laws were unknown.

It is gratifying to find that government have liberally granted £1500 to Mr. Babbage to enable him to complete one of these machines on a great scale.

6. *Description of Richardson's Lifting Plug.*

Description of Richardson's lifting plug.

In elevating large stones, a small piece of iron called a lewis has been generally employed. A cylindrical hole cut in the stone, and made wider below than above, receives the lewis, or a cylindrical piece of iron, which is made to widen at its lower end, so as to fill the enlarged part of the cylindrical bore. The lewis, therefore, cannot be pulled out of the stone without carrying away a portion of it; so that if the stone is tough, the mass may be elevated by applying the power to the upper end of the lewis.

The lifting plug invented by Mr. Richardson of Keswick, is a much more simple and efficacious contrivance. A small cylindrical hole, about two inches deep, is cut perpendicularly, or nearly so, out of the stone by the common steel boring chisel of masons. A common cylindrical plug of iron, about a 20th or 30th part of an inch less in diameter than that of the hole, is now driven into it about an inch deep, by two or three blows of a hammer; and with no other fastening the heaviest stones may be raised, and the largest masses of stone torn up from the ground. The cause of the firm adhesion of the iron plug to the stone, is no doubt the elasticity of the stone, which grasps, as it were, the plug in the same way as wood does a polished nail which is driven into it. When it is required to detach the plug from the stone, nothing more is requisite than a sharp stroke or two from a hammer. The principle on which this experiment depends may find numerous applications. By the same means, a vessel of any size might be moored, and masses of stone held together as firmly as if they were of one piece.

OPTICS.

In our Article on OPTICS, and in our Articles on the KALEIDOSCOPE, the MICROSCOPE, and the TELESCOPE, we have described several of the most popular and amusing instruments which depend upon light and vision. Several very curious instruments and experiments, however, still remain to be described under the present head.

1. *The Thaumatrope.*

The Thaumatrope.

The thaumatrope, (or the *wonder turner*, from θαυμα a *wonder*, and τρεπω to turn,) a very ingenious philosophical toy, invented, we believe, by Dr. Paris, is founded on the well known optical principle, that an impression upon the retina continues for about the eighth part of a second after the object which produced it is withdrawn. The luminous rings formed by the whirling of a burning stick in the dark are well known, and Homer has availed himself of the same principle in his description of the lengthened shadow of the flying javelin.

The thaumatrope consists of a number of circular pieces of card, about two and a half inches in diameter, which may be twirled round with great velocity by the application of the fingers to pieces of silk string attached to two opposite points of their circumference. On each side of a card is painted a part of a picture, so that if we could see both sides at once, the two parts of the picture would form a whole picture. For example, in Pl. CCCCLXXXVI. Fig. 1, we have shown two sides of a card, on one of which is a cage, and on the other a bird. If we now take hold of each of the silk strings A and B, between the fore-finger and thumb of each hand, and put it into a twirling motion, the bird and the cage will appear to the eye at the same moment, in consequence of the impression of each continuing upon the retina for a short space of time. The following are some of the other devices on the cards of the thaumatrope.

PLATE CCCCLXXXVI. Fig. 1.

A rose tree, with a garden pot on the reverse.

A horse, with a man on the reverse.

A leafless branch, which becomes verdant on the twirling of the card.

A female in one dress on one side, and another dress on the other.

The body of a Turk, with his head on the reverse.

The Watchman's box on one side, and himself on the other.

Harlequin and Columbine on different sides, appear together by the revolution of the card.

A comic head on one side, which, on turning round, becomes invested with a wig.

A man sleeping, and awakened by being turned round.

The principle of the thaumatrope may be extended to many other devices. Parts of a sentence may be written on one side, and the rest of the sentence on the other; and we may even put halves of the letters on one side, and the other halves on the other side.

Those who have used the thaumatrope, must have been dissatisfied with the general effect of the two combined pictures. There is a hobbling motion arising from the imperfection of the method adopted to produce the rotatory motion, which entirely destroys the effect; and it is perfectly clear that the rotatory motion should be produced by quite different means. If strings are adopted, they ought to be attached to the circular pieces of card, so that the axis of rotation should be in the plane of the card; but a solid axis of rotation is decidedly preferable. See Dr. Brewster's *Journal of Science*, No. VII.

On the apparent direction of eyes in a portrait.

2. *On the Apparent Direction of Eyes in a Portrait.*

A very curious paper on this subject has been recently published by Dr. Wollaston, in the *Philosophical Transactions*, for an abstract of which will be interesting to most of our readers.

In examining the eyes of a person opposite to us, and looking horizontally within a range of about 20° on either side of us, we shall find that the white parts of the eye increase and decrease according as they are turned to or from the nose. When the eyes are looking straight at us, the two portions of white are nearly equal, so that by the relative magnitudes of the white parts of each eye we can estimate in what degree the eyes deviate in *direction from the face to which they belong*.

LATE CCLXXXVI. . 2, 3.

In judging, however, *of their direction in reference to ourselves*, we are not guided by the eyes alone, but by the concurrent position of the entire face. This will be understood from Plate CCCCLXXXVI. Fig. 2. where the pair of eyes were originally drawn from the life by Sir Thomas Lawrence, actually looking at him. The face has been added according to the original design, so that the person represented in Fig. 2. appears decidedly looking at the spectator. If, however, a set of features oppositely turned are applied to the same eyes as in Fig. 3. by lifting up the piece of paper, the eyes will be found to look considerably to the right of the person viewing them.

ig. 4, 5.

The same principles apply to instances of moderate inclination of the face upwards or downwards; but the principle is most strikingly exemplified when the turn of a pair of eyes partakes of both inclinations, so as to be in a direction laterally upwards, as in Fig. 4. By giving the face a downward cast, as in Fig. 5. the change of effect is very remarkable. Dr. Wollaston considers these examples as proving that the opposite direction of the eyes to or from the spectator, depends on the balance of two circumstances combined in the same representation, viz. 1. The general position of the face presented to the spectator; and, 2. The turn of the eyes from that position. In the same manner as the general position of the face carries the eyes along with it, so a change in the position of the eyes carries the face along with them. This fact, which is not mentioned by Dr. Wollaston, is not less surprising than its counterpart, and may be well illustrated by causing a pair of invisible eyes to oscillate in the sockets of the eyes of a picture.

Dr. Wollaston next proceeds to explain a fact which every person must have observed, that if the eyes of a portrait look at the spectator when he stands in front of the picture, they follow and appear to look at him in every other direction. His explanation and illustration of this is every way satisfactory; but not so popular as we think it may be made. The following illustration appears to us more easily comprehended. If a picture represents three soldiers, each firing a musket in parallel directions, and if the musket of the middle one is pointed accurately to the eye of the spectator, then the muzzle of the musket will be exactly circular, and the spectator will see down the barrel, and no part of the right or left side of the barrel. In like manner, the spectator will see the left side of the barrel of the soldier opposite his left hand, and the right side of the barrel of the soldier opposite his right hand. If the spectator now changes his place, and takes ever such an oblique position, either laterally or vertically, he must see the same thing, because nothing else is painted on the canvas. The gun of the middle soldier must always point to the eye of the spectator, the gun of the other to the right of him, and the gun of the third to the left of him. They will, therefore, all three seem to move as he moves, and follow him in his motions. The same reasoning is applicable to perspective buildings. See Dr. Brewster's *Journal of Science*, No. VII.

3. *On the Optical Illusion of the Conversion of Cameos into Intaglios, and of Intaglios into Cameos, and other Analogous Phenomena.*

On the optical illusion of the conversion of cameos into intaglios, and of intaglios into cameos, and other analogous phenomena.

At one of the early meetings of the Royal Society of London, when a compound microscope on a new construction was exhibited, some of the members, while looking through it at a guinea, saw the head upon the coin depressed, while to others it appeared to be raised, as it was in reality.

The same phenomenon was afterwards observed by Dr. P. F. Gmelin of Wurtemberg, while examining objects through telescopes and compound microscopes; and he seems to have studied it with considerable care. The protuberant parts of objects appeared depressed, and the depressed parts protuberant; but this happened in some cases and not in others, at some times, and not at others, and to some eyes and not to others. After a variety of trials he observed the following constant effects. When he looked at any object which was neither white nor shining, rising upon a plane, with the eye and the optical tube directly opposite to it, the elevated parts appeared depressed, and the depressed parts elevated. Dr. Gmelin is said to have discovered a method of making objects always appear with their natural convexity, viz. by directing his sight at first to the edges of the convexity, and then gradually taking in the whole.

Plate CCCCLXXXVI Fig. 6.

Fig. 7.

Before we proceed to explain the principles on which this illusion depends, we shall first describe the best method of observing it. It will afterwards be seen, that telescopes and microscopes are not necessary to its production; but it may be best seen by viewing with the eye-piece of an achromatic telescope the engraving upon a seal, when illuminated either by a candle or the window of an apartment. This eye-piece inverts the objects to which it is applied like the compound microscope, and the excavations or depressions of the seal are immediately raised up into elevations like a cameo, or a bas-relief. The cause of this illusion will be understood from Plate CCCCLXXXVI. Fig. 6. where A represents a spherical cavity illuminated by a candle C. The shadow of the cavity will of course be on the left side S, and therefore if we view it through an inverting eye-piece or microscope, the cavity will be seen as at A, Fig. 7. with its shadow on the right hand S of the cavity. As the candle C remains where it was, the observer instantly concludes that what was formerly a cavity must now be a spherical elevation or segment of a sphere, as nothing but a raised body could have its shadow on the right hand S. If a second candle is now placed on the right hand side of A, so that it is between two candles, and is equally illuminated by both, the elevation will again sink into a cavity as in Fig. 6.

If the object A, in place of being a cavity, is actually the raised segment of a solid sphere, the same phenomena will be observed, the inverting eye-piece converting it into a cavity. These two experiments may be made most successfully with a seal, and an impression taken from it.

It cannot therefore be doubted, that the optical illu-

rays parallel, diverging and converging.—If the radiant point or object from which rays diverge is a little within the anterior principal focus of a spherical lens, the central parts of the lens will render the diverging rays slightly *divergent*, the part of the lens without this will render them *parallel*, and the outer rim will cause them to converge to a positive focus behind the glass.

The same effect may be produced by a reflecting mirror.

11. *On the Convergency of the Solar Beams to a point opposite to the Sun.*

On the convergency of the solar beams to a point opposite to the sun.

The divergency of the solar beams, when the sun is descending in the west, is a phenomenon which occurs so frequently, that the most careless observer must have had occasion to notice it. This phenomenon, however, is sometimes accompanied with one of an opposite kind, viz. the *convergency of the solar beams to a point opposite to the sun, and as far below the horizon as the sun is above it.* This phenomenon is extremely rare; and we are not aware that it has been described more than once, viz. by Dr. Robert Smith of Cambridge, who observed, that he *once* saw it upon Lincolnheath. He describes it as "an apparent convergence, of long whitish beams, towards a point diametrically opposite to the sun. For as near as I could estimate, it was situated as much below the horizon as the sun was then elevated above the opposite point of it." "In the unusual phenomenon," Dr. Smith afterwards adds, "I well remember, that the converging sun-beams towards the point below the horizon, were not quite so bright and shining as those usually are which diverge from him, and that the sky beyond them appeared very black, which certainly contributed to the evidence of this appearance." Smith's *Optics*, vol. ii. Remarks, p. 57, 58.

On Saturday, the 9th October, 1824, Dr. Brewster had the pleasure to observe this curious phenomenon when travelling from Melrose to Edinburgh, and of pointing it out to two friends who accompanied him. It was first seen at that part of the road opposite to the avenue to Kirkhill, the seat of John Tod, Esq. at about a quarter past four o'clock. The sun was then considerably elevated above the Pentland range of hills, and was throwing out his diverging beams in great beauty through the interstices of the broken masses of clouds which floated in the west. The eastern part of the horizon, where the converging lines were seen, was occupied with a dark black cloud, as described by Dr. Smith, and which seems necessary as a ground for rendering visible such faint radiations. The converging beams were much fainter than the diverging ones, and the point to which they converged was as near as could be estimated, as far below the horizon as the sun was above it. About ten minutes after the phenomenon was first seen, the convergent lines *were black* or very dark. This arose from the real beams having become broad, and of irregular intensity, so that the eye took up, as it were, the spaces between the beams more readily than the beams themselves.

In order to explain the cause of this phenomenon minutely, several diagrams would be necessary, for which we cannot at present find room; but we think it may be perhaps more easily understood from the following illustration.

Let us suppose a line to join the eye of the observer and the sun; let rays issue from the sun in all possible directions, and let us suppose that planes pass through these radiations, *and through the line joining the observer and the sun*, which will be their common intersection, like the axis of an orange, or the axis of the earth, through which there passes all the septa of the former, and all the planes passing through the meridians of the latter. An eye, therefore, situated in that line or common intersection of all the planes, will see them diverging from the sun on one side, and converging towards the opposite point, just as an eye in the axis of a globe would perceive all the planes passing through the meridians, diverging on one side and converging on another. See Dr. Brewster's *Journal of Science*, Vol. II. p. 136.

12. *Improvements on the Magic Lantern.*

In our article Optics, Vol. XV. p. 630, we have described the magic lantern in its general form. A very considerable improvement, however, has lately been introduced into the construction of the sliders on which the objects are painted, by which very curious transformations are produced. In one of these the eyes are left empty in the picture of a fine old head, and by moving another slider containing a pair of eyes, from one side to another, the head appears to turn as if it were alive. In another a smith is seen with his hammer resting on the anvil, and by repeatedly pushing forward a subsidiary slider and drawing it back, the smith raises his arm and strikes the iron, from which sparks immediately issue. In the same way various changes in the attitude, the dress, and the action of figures on the sliders may be introduced into the picture, which give a great variety, and a new interest to the formerly tame representations of the magic lantern.

13. *Singular optical illusion seen through a telescope.*

If we direct a telescope to the surface of a distant field on which there are no objects, such as trees, houses, &c. and if the field of the telescope contains nothing but the surface of the field, the eye will speedily recognize that the field is horizontal or slightly inclined to the horizon, from the perspective of the furrows or drills upon its surface, or even from its aerial perspective, provided the difference in the distances of the nearer and the remoter end is considerable, and the air sufficiently hazy.

The field, however, may be so situated, and have such an inclination, that when seen through the telescope it appears like a perpendicular or vertical wall of earth. This phenomenon we have often seen in directing a telescope to a field above Melrose Abbey on the northern acclivity of the north-west Eildon Hill. This field is capable of being ploughed in the direction of its greatest declivity; but when it is viewed through a telescope, the slope is such that the furrows do not appear to converge, and the eye cannot readily perceive any difference between the breadth of the furrows at the remote end of the field, and their breadth at the near end. The observer, therefore, immediately concludes that the field must be nearly a vertical plain rising in front of him. This deception is a very remarkable one, and produces a singular effect on the mind when the field is covered with a crop and when crows, &c. light upon it. I have not yet observed the effect produced when it is in the act of being ploughed. It is very probable that the impossibility of ploughing a vertical plain may remove the deception upon the principles which we have already explained in another part of this article. See Dr. Brewster's *Journal of Science*, No. VII.

14. *Optical deception of Le Cat.*

M. Le Cat has described a curious optical deception in which an erect object placed near a hole in a card next the eye appears to be on the other side, and also inverted and magnified. Let CD Fig. 19, be a card perforated with a small hole, E a white wall or window, D the eye of the observer, and *d* the head of a pin held near the eye and also near the hole in the card. Under these circumstances the pin *d* will be seen at F inverted and magnified. The reason of this is, as M. Le Cat has observed, that the eye in this case sees only the shadow of the pin on the retina, and since the light which is stopped by the upper part of the pin on its head comes from the lower part of the white wall or window F, and that which is stopped by the lower end of the pin comes from the upper part of the wall or window E, the shadow must necessarily appear inverted with respect to the object.[*]

The following variation of Le Cat's experiment has been described by Dr. Brewster. Take a common pin and hold it in any position near the eye so that the observer sees reflected from its head a faint circle of light, then hold a second pin opposite to it exactly as in Fig. 19, and an inverted image of the one pin will be seen in the head of the other. If the head of the first pin is round and well polished, the inverted and magnified image of the other will be more distinct. In this form of the experiment a diverging pencil of light from the window or a candle replaces the diverging pencil in Fig. 19. which proceeds from the perforation in the card CB, and of course produces the same effect. The little round knob, by the pressure upon which the case of a watch is often opened, will answer better than the finest pin head. *Edin. Jour. of Science*, No. VII. p. 89.

15. *On the Insensibility of the Retina to objects seen indirectly, and to objects faintly illuminated.*

If we look, says Dr. Brewster,[†] at a narrow slip of white paper placed upon a black or a coloured ground, it will never appear to vanish, however long and attentively we view it. But if the eye is fixed steadily upon any object within two or three inches of the paper, so as to see it only *indirectly*, or by oblique vision, the slip of paper will occasionally disappear, as if it had been removed entirely from the ground, the colour of the ground extending itself over the part of the retina occupied by the image of the slip of paper.

If the object seen indirectly is a *black* stripe on a white ground, it vanishes in a similar manner; and, what is still more remarkable, the same phenomena of disappearance take place *whether the object is viewed with one or with both eyes.*

When the indirect object is luminous, like a candle, it never vanishes entirely, unless it is placed at a great distance; but it swells and contracts, and is surrounded by a halo of nebulous light, so that the excitement must extend itself to contiguous portions of the retina which are not influenced by the light itself.

If we place two candles at the distance of about eight or ten feet from the eye, and about twelve inches from each other, and view the one directly and the other indirectly, the indirect image will be encircled with a bright ring of *yellow* light, and the bright light within the ring will have a pale blue colour. If the candles are viewed through a prism, the red and green lights of the indirect image vanish, and leave only a large mass of yellow, terminated with a portion of blue light.

While performing this experiment, and looking steadily and directly at one of the prismatic images of the candle, I was surprised to observe that the red and green rays begin to disappear, leaving only *yellow* and a small portion of *blue*; and when the eye was kept immoveably fixed on the same part of the image, the yellow light became almost pure white, so that the prismatic image was converted into an elongated image of white light.

If the slip of white paper, viewed indirectly with both eyes, is placed so near as to be seen double, the rays which proceed from it no longer fall on corresponding points of the retina. In this case, the two images do not vanish simultaneously; but when the one begins to disappear, the other begins soon after it, so that they sometimes appear to be extinguished at the same time.

In order to ascertain whether or not the accidental colour of an object seen indirectly would remain after the object itself had disappeared, I placed a rectangular piece of a *red* wafer upon a white ground, and having looked steadily at an object in its vicinity, the wafer disappeared, and though the accidental colour showed itself just before the wafer had vanished, yet no trace of colour was visible afterwards.

The insensibility of the retina to *indirect impressions* has a singular counterpart in its insensibility to the *direct impressions* of attenuated light. When the eye is steadily directed to objects illuminated by a feeble gleam of light, it is thrown into a condition nearly as painful as that which arises from an excess of splendour. A sort of remission takes place in the conveyance of the impressions along the nervous membrane; the object actually disappears, and the eye is agitated by the recurrence of excitements which are too feeble for the performance of its functions. If the eye had, under such a twilight, been making unavailing efforts to read, or to examine a minute object, the pain which it suffers would admit of an easy explanation; but, in the present case, it is the passive recipient of attenuated light, and the uneasiness which it experiences can arise only from the recurring failures in the retina to transmit its impressions to the optic nerve.

The preceding facts respecting the affections of the retina, while they throw considerable light on the functions of that membrane, may serve to explain some of those phenomena of the evanescence and reappearance of objects, and of the change of shape of inanimate objects, which have been ascribed by the vulgar to supernatural causes, and by philosophers to the activity of the imagination. If in a dark night, for example, we unexpectedly obtain a glimpse of any object, either in motion or at rest, we are naturally anxious to ascertain what it is, and our curiosity calls forth all our powers of vision. This anxiety, however, serves only to baffle us in all our attempts. Excited only by a feeble illumination, the retina is not capable of affording a permanent vision of the object, and while we are straining our eyes to discover its nature, the object will entirely disappear, and will afterwards appear and disappear alternately.[‡] The same phenomenon may be

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[*] See Le Cat's *Traité des Sens*, p. 298, and Priestley *On Vision*, Vol. ii. p. 725.

[†] *Edinburgh Journal of Science*, Vol. iii. p. 288.

[‡] An analogous phenomenon, but arising from a quite different cause, must have often been observed by persons who are very long-sighted. In a dark night, the pupil dilates to such a degree as to deprive the eye of its power of adjusting itself to moderate distances. (See

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observed in day light by the sportsman, when he endeavours to mark, upon the monotonous heath, the particular spot where moor-game has alighted. Availing himself of the slightest difference of tint in the adjacent heath, he keeps his eye steadily fixed upon it as he advances; but whenever the contrast of illumination is feeble, he invariably loses sight of his mark, and if the retina is capable of again taking it up, it is only to lose it again.

Mr. Herschel and Mr. South, see the *Phil. Trans.* 1824, Part iii. p. 15. have recently observed a very curious fact, which has some analogy with the phenomena now described.

"A rather singular method," they remark, "of obtaining a view, and even a rough measure of the angles of stars, *of the last degree of faintness*, has often been resorted to, viz. to *direct the eye to another part of the field*. In this way, a faint star, in the neighbourhood of a large one, will often *become very conspicuous*, so as to bear a certain illumination, which will yet *totally disappear*, as if suddenly blotted out, when the eye is turned full upon it, and so on, *appearing* and disappearing alternately, as often as you please. The lateral portions of the retina, less fatigued by strong lights, and less exhausted by perpetual attention, are probably more sensible to faint impressions than the central ones, which may serve to account for this phenomenon."*

As it is with much diffidence that I venture to controvert any opinion entertained by Mr. Herschel, I have been at some pains to investigate the subject experimentally. I was, at first, disposed to ascribe the evanescence of the faint star, solely to the same cause as the evanescence of faintly illuminated surfaces, and the reappearance of the star by indirect vision, to the circumstance of the retina recovering its tone, by contemplating another object sufficiently luminous for vision; but this opinion was not well founded.

If a given quantity of light, which is unable to afford a sustained impression when expanded over a surface, is concentrated into a luminous point, it is still less fitted for the purposes of vision. It then acts upon the retina somewhat in the same way as a sharp point does upon the skin. The luminous point will alternately vanish and reappear; and if the retina is under the influence of a number of such points, it will be thrown into a state of painful agitation. The same effect is produced by a sharp line of light; the retina is, in this case, thrown into a state of undulation, so as to produce an infinite number of images parallel to the luminous line; and when this line is a narrow aperture held near the eye, a sheet of paper, to which it is directed, will appear covered with an infinity of broken serpentine lines parallel to the aperture. When the eye is stedfastly fixed, for some time, upon the parallel lines which are generally used to represent the sea in maps, the lines will all break into portions of serpentine lines, and *red*, *yellow*, *green*, and *blue* tints will appear in the interstices of them.

The evanescence of stars, therefore, of the last degree of faintness, must be ascribed, both to their deleterious action upon the retina as points of light, and to the insufficiency of their light to maintain a continued impression upon that membrane.

When the same star is seen by indirect vision, it reappears with a degree of brightness which it never assumes when seen directly by the eye. When the eye is adjusted to the distinct perception of an object placed in the axis of vision, an object placed out of the axis cannot be seen with the same distinctness, both from the pencils not being accurately converged upon the retina, and from the expansion of the image, which, as we have already described, accompanies indirect vision. A luminous point, therefore, seen indirectly, swells into a disk, and thus loses its sharpness, and acts upon a greater portion of the retina.† In order to determine whether this expansion, and the image of the luminous point, was the cause of its superior visibility, I turned my eye full upon a luminous point till it ceased to be visible, and then re-adjusting my eye, so as to swell the point into a circular disk by direct vision, I invariably found that its visibility was instantly increased. If this explanation of the phenomenon be the correct one, the practical astronomer may, with direct vision, obtain a clearer view of minute and faint stars, either by putting the telescope out of its focus, or by adjusting his eye to nearer objects."

16. *Singular Illusion in examining a Dioramic Picture.*

In examining a dioramic representation of the inside of Rochester cathedral, which produced the finest effect from the entire exclusion of all extraneous light and of all objects, excepting those on the picture itself; the writer of this article was struck with an appearance of distortion in the perspective, which he ascribed to the canvas not hanging vertically. Upon mentioning this to the gentleman who exhibited the picture, he offered to walk in front of it, and strike its surface with the palm of his hand, to show that the canvas was freely suspended. Upon doing this, a very remarkable deception took place. As his hand passed along, it gradually became larger and larger, till it reached the middle, when it became enormously large. It then diminished till it reached the other end of the canvas.

As the hand moved towards the middle of the picture, it touched parts of the picture more and more remote from the eye of the observer, and consequently the mind referred the hand, and the object in contact with it to the same remote distance, and consequently gave it an apparent magnitude such as a body of its size would have had at the distance of the part of the picture which it covered.

We have seen an analogous illusion when viewing the mosaic pavement of St. Paul's from the inside of the cupola. The lozenges had a certain apparent magnitude when seen alone, which of course was small. When a person, however, passed over the pavement, our knowledge of his size furnished us with a scale

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Edinburgh Journal of Science, Vol. I. p. 80.) Hence, if an object presents itself within that distance, the observer must see it with a degree of indistinctness which cannot fail to surprise him, especially as all distant objects, particularly those seen against the sky, will appear to him with their usual sharpness of outline.

* A similar fact with regard to the satellites of Saturn was noticed by some of the astronomers in the Royal Observatory of Paris.

† The eye is not capable of observing the *colours* of luminous points seen indirectly. A *blue* luminous point, for example, appears nearly *white*, and so do points of any other colour.

for measuring the real magnitude of the compartment in the pavement, and they accordingly increased in size, diminishing again when the person had passed from our view. *Edin. Jour. of Science,* No. VII. p. 90.

17. *Mr. Ritchie's Improvement on the Phantasmagoria.*

In our article OPTICS, Vol. XV. p. 630, we have already described the phantasmagoria. The following improvement upon it has been proposed by Mr. Ritchie of Tain.

"In the common phantasmagoria," says Mr. Ritchie, "the object becomes brighter and brighter as it diminishes, or as it seems to retire, till it verges into a luminous point. Now this is so completely contrary to what takes place in nature, that the momentary belief of reality, so forcibly impressed on the mind, becomes gradually weakened, and at last totally vanishes. To supply this defect, I would therefore propose the following alteration, which will render the deception more natural and striking. Let a small portable gasometer be procured, capable of holding a sufficient quantity of condensed oil gas. Let a stop cock, having a small groove, gradually deepening, be adapted to it, so that the quantity of gas escaping to the burner may be increased or diminished at pleasure. By diminishing the light according to a certain law, the brilliancy of the object will be gradually improved as it retires, the lineaments of the figure will become shadowy and obscure, and the phantom itself will at length vanish into thin air." See *The Edinburgh Journal of Science,* No. vii. p. 37.

PNEUMATICS.

1. *Description of the Common Air Gun.*

The air gun of the ordinary construction consists of two brass barrels, viz. of an inner barrel A, Fig. 20. Plate CCCCLXXXVI. from which the bullets are discharged, and a larger barrel ECDR on the outside of the former, for containing the compressed air. A syringe SMNP is fixed in the butt end of the gun, which, by means of its piston, barrel and valves, condenses the air through a valve EP, in the outer barrel ECDR. The ball K is rammed down into the barrel A in the usual manner, and when the trigger O is pulled it opens a valve at SL, which allows the compressed air to escape, and press with all its force against the bullet, so as to discharge it with immense velocity. By continuing to press upon the trigger, the whole charge of condensed air may be let off at once, so as to impell the ball with the greatest force which the gun is capable of furnishing; but if it is pulled quickly, and allowed to return, several bullets may be discharged by one condensation.

An air gun on an improved construction is shown in Fig. 21. where A is the barrel, resembling that of a common gun, and *c* a hollow copper vessel, perfectly air tight, screwed to a steel tube *b*, having a moveable pin in the inside, which is pushed aside by the action of the lock and the pulling of the trigger. The copper ball *c* is charged by means of the condensing syringe B, Fig. 22. and then screwed on to the tube *b*. The ball being put into the barrel A, and the trigger *a* pulled, the valve will open, and the whole of the condensed air will rush out, and impell the ball with great force. The charge of air in the vessel is sufficient for 15 or 16 discharges.

In the inside of the copper ball is a valve and spring which permits air to enter the ball, but which closes tightly by the pressure of the air when it attempts to escape. The copper ball is screwed tightly to the top of the syringe at *b*. The handles HH are fixed to the barrel B of the syringe, and by pulling them up and down the air is condensed in the ball.

Magazine air gun. Figs. 23, 24, 25.

The magazine air gun, invented by M. Colbe, is represented in Figs. 23, 24, and 25. The object which the artist had in view was to discharge in succession ten bullets lodged in a cavity. In the representation of the air gun in Fig. 23. the stock is cut off at the extremity of the condensing syringe, the valve of which opens into the cavity between the barrels. The shooting barrel KK receives the bullets in succession from the magazine ED, which is closed at D when the bullets are put in. The circle *a b c* is the key of a cock perforated by a cylindrical tube, having its diameter equal to that of the barrel KK. In Fig. 23. this cylindrical tube makes part of the barrel, and the communication between it and the magazine ED is cut off. The axis in which the cock *a b c* turns is a square piece of steel *h*, in the end of which is put the square hole of the hammer HH, shown in Figs. 24. and 25. By turning, therefore, the hammer HH, the cylindrical perforation in the cock, which in Fig. 23. coincides with the barrel KK, may be placed in the position *i k*, Fig. 25. so as to communicate with the magazine ED. If the gun is now held beneath the arm with the face AB of the barrel downwards, and the magazine ED upwards, one of the bullets *b* next the end *k* of the cock will fall into the barrel, where it will be detained in the proper position by the small springs *ss*. By again opening the cock as in Fig. 25. the communication between it and the magazine is cut off, and the bullet is ready to be discharged. This is effected by the combination of levers shown in Fig. 23. which become visible by taking off the lock. When the trigger ZZ, Fig. 23. is pulled by the part within the guard C, its dotted end Z′ within the stock raises the end *y* of the scer *y a*, and by depressing the end *a* disengages it from the notch near *a* upon which the powerful spring WW moves the tumbler T to which the cock is fixed. The end *u* of the tumbler depresses the end *v* of the lever, and its other extremity *m*, raises at the same time the flat end *l* of the horizontal lever Q, which, by its vertical ascent, elevates the pin *p* P which rests upon it. This pin pushes up the conical brass valve V from its conical seat into which it is nicely ground, and admits the condensed air which drives out the bullet. This valve instantly shuts by the action of the long spring NN made of brass, and is again opened in a similar way to produce subsequent discharges. It has been found that twelve penny weights of air thrown into a ball 33½ inches in diameter will discharge 15 balls.

Montucla ascribes the invention of the air-gun to Otto Guericke, the inventor of the air-pump; but David Rivant, in his *Elemens d'Artillerie,* ascribes it to M. Marin, a burgher of Lisieux, who presented one to Henry IV.

2. *The Ascending Snake.*

The ascending snake.

This little toy, depending on the ascent of a current of heated air from a fire place, is one of the prettiest pneumatic experiments which we have seen, and has the advantage also of illustrating the action of several pieces of machinery. We do not know who invented it, and we are not aware that it has been any where described.

Plate CCCCLXXXVI. Figs. 26, 27.

Take a stiff piece of card, or sheet copper, or brass, about two and a half, or three inches in diameter, and cut it out spirally, so as to resemble a snake, having its head at *b* and its tail at *a*, as in Fig. 26. The body having been well painted, so as to resemble a snake, take it by the two ends *a b*, and draw out the spiral till the distance *a b* is 6 or 7 inches, as in Fig. 27. Having provided a slender piece of wood *c d*, on a stand *d*, and fixed a fine sharp-pointed needle at its summit, push the rod *c d* up through the spiral, and let the end *a* of the spiral rest upon the summit of the needle. The apparatus being now placed as near as possible to the margin of the marble shelf above the fire, the snake will begin to revolve in the direction of its head; and if the fire is strong, or the current of heated air which ascends from it is made powerful by two or three persons coming near it, so as to concentrate the current, the snake will revolve with very great rapidity. The rod *a b* should be painted so as to resemble a tree, which the snake will appear to climb.

If the body of the snake, in place of going from right to left, as in Fig. 26, goes from left to right, it will move in the contrary direction when put up. When a right and a left handed snake are put up near one another, the interfering shadows of them produced by one or more strong lights has a very singular effect.

If a small steel pivot is thrust up through the extremity of the tail *a*, the snake may be suspended at the end of a magnet by the steel pivot, the quantity of steel being made just sufficient to enable the magnet to support the weight of the snake. In this case there is no need of the stand *c d*.

3. *The Inflaming Condenser.*

The inflaming condenser.

It has been long ago observed, that when the ball of an air gun was filling with condensed air by means of the syringe, a flash of light was often perceived. It has also been found, that the thermometer always rises in condensed air.

Fig. 28

These results have given rise to a small condenser, A B, Fig. 28, made of brass, and wrought by the piston C D. A small piece of amadou, which easily takes fire, is placed in the end B, which screws off rapidly, but at the same time is air-tight. The piston C D being pushed down with great smartness, the heat disengaged by the condensation of the air inflames the amadou at B. By screwing off the end B quickly, a match may be lighted at the amadou.

This apparatus has been constructed on such a scale as to inflame gun-powder placed in the end B.

4. *To support a Ball on a Jet of Air.*

To support a ball on a jet of air.

Every person must have seen the experiment of supporting, for any length of time, a ball upon the summit of a jet of water. The same may be done upon the summit of a jet of condensed air. It has been long a practice of school-boys to perform this experiment in a very dexterous manner by means of a quill, or the stalk of a tobacco-pipe and a pea; and some of them often acquire the art to such a degree, as to make the experiment a very surprising one. When a jet of condensed air is used, the ball follows the play of the jet with more regularity.

If the condensed air is coal or oil gas, as in Mr. Gordon's portable lamp; and if the gas is set on fire, the phenomenon of the supported ball is very curious. This experiment was, we believe, first made by Mr. Deuchar.

5. *Description of a Rotatory Gas Burner.*

Various attempts have been made to construct a gas burner which should revolve, upon the principle of Barker's mill, by means of the reaction of the gas issuing under the ordinary pressure at which it is burned. If the place round which the motion is performed is an ordinary gas-tight joint, the friction is so great that a motion of rotation cannot be obtained unless the gas has been greatly condensed so as to issue under the pressure of many atmospheres. A rotatory burner of this description was made last year by Mr. Deuchar, but it was nothing more than a philosophical experiment quite inapplicable to gas as it is generally used.

The rotatory gas burner, which is represented in Plate CCCCLXXXVI. Fig. 29. is the invention of Mr. Nimmo, brassfounder in Edinburgh. It displays great ingenuity, and revolves by the reaction of gas issuing at the ordinary pressure.

In the section of it in Fig. 29, PQR is the gas tube communicating by its lower end PQ with any gas pipe. This tube, which is conical at its upper end R, terminates in a sharp pivot at R, and has several large holes *a* made in it near the top, so as to allow the gas to escape. On the outside of the tube PQR, and fixed to it at PQ is the water tube ABCDPQ which is filled with water. These parts of the burner are all stationary.

The revolving part consists of two horizontal tubes crossing one another at right angles. Only one of these tubes EF is seen in the section. These tubes communicate with the vertical tube GHMN, the lower end of which MN is open, and is immersed in the water tube ABCD, the whole resting upon the pivot above R, and revolving upon it as a centre. This revolution is effected in the following manner. The gas ascending the tube PQR escapes through the openings in it at *a*, and being prevented by the water within the tube GHMN from getting out at its open end MN, it fills the tubes EF, and issuing at the holes *h, h* at their extremities, its reaction upon the opposite sides of the tube produces a horizontal rotatory motion, the vertical tube GHMN revolving freely in the water in the tube ABCD.

If the contrivance now described formed merely an elegant addition to our gas light apparatus, it would even in this point of view possess considerable interest; but there is reason to think that by a proper adjustment of the velocity of rotation to the quantity of gas discharged, the flame may be supplied with the requisite quantity of air more perfectly than can be done in a stationary burner. If this shall turn out to be the case, the rotatory gas burner may be the most economical contrivance for burning gas.

SCILLY ISLES. The name of a group of islands situated about thirty miles to the west of the extremity of Cornwall, called the Land's End. They are visible in good weather from this point, and appear like rugged cliffs rising out of the Atlantic. From Penzance, a distance of fourteen leagues, they may be reached in favourable weather in four or five hours.

The inhabited islands are six in number, viz. *St. Mary's, Trescaw, St. Martin's, St. Agnes, Sampson* and *Brehar*.

St. Mary's island, which is the largest and the best cultivated of the group, is about ten miles in circuit. The principal place is Newtown or Heughtown, the capital of the Scilly Isles. It consists of a long street intersected by two shorter ones. The pier built by Lord Godolphin in 1750, is at the west end of the town: It is 430 feet long, and receives vessels of 150 tons. The chief buildings are the church about a mile from the town, a custom-house, a council-house, and a prison. In the vicinity are the ruins of a fortress with a moat, and of several blockhouses and batteries. About a mile and a half from the new town is the old town, once the principal place in the island. Vestiges of its castle still remain. Near Giant's Castle Bay, are several rocking stones about twenty feet long. Churchtown is the third town in the island.

Trescaw, the second island in point of size, is about half the size of St. Mary's, and lies to the south-west of it. Dolphin, the chief place, has a church and about thirty houses. The principal harbours are those of Old and New Grimsby. Cromwell's castle, now in decay, stands on the east side of New Grimsby harbour. The island contains about 465 inhabitants.

St. Martin's, a little smaller than Trescaw, is about a mile to the east of it. It is about six miles in circuit, and contains about 720 acres. It was uninhabited about 150 years ago, but has now a population of 235 persons.

St. Agnes is situated about three miles south-west of Heughtown, and is about four miles in circumference. Here there is a singular rock called the Giant's Punch Bowl, which has an excavation in its upper surface, seven feet wide and three feet deep. The lighthouse, which stands on a lofty eminence, is a stone building seventy-two feet high. This island has 244 inhabitants.

Brehar or Breyer lies to the west of Trescaw, and contains 111 inhabitants. It is very mountainous, and contains many small burrows, and one large circular one of stone, which is seventy-seven feet in diameter, containing many kistvaens or stone cells.

Sampson is composed of two circular hills united by a low rocky ledge. On the top of one of them are eleven stone burrows, and on the other, various ruins of houses, &c. The inhabitants are thirty-two in number.

The climate of the Scilly Isles is mild and salubrious. Wheat is grown, but in less quantity than barley. The horses and cattle are small, and sheep and rabbits abound.

The civil concerns of the islands are chiefly managed by twelve of the principal inhabitants, who meet at Heughtown every month and settle differences by compromise. Criminal causes are referred to the military power. The inhabitants are employed principally in husbandry, fishing, and making kelp. The total population of the island is about 2000. See the *Beauties of England and Wales*, Vol. II. p. 479.

Scinde

SCINDE, SINDE, SINDHU, an extensive country in Hindostan, situated between 23° and 27° of North Lat. and 67° and 71° of East Long. It is bounded on the south by Cutch and the Indian Ocean, on the east by the provinces of Marwar, Joudpore, and Jesselmere, on the north by Bhukor, Moultan, and the territory of the King of Cabul, and on the west by Mekran and the mountains of Balouchistan. The Indus, which carries its fertilizing branches through the country, forms a delta stretching about 100 miles along the east coast. The Indus joins the Punjab a few miles south-west of Chasepoor in North Lat. 28° 31′, and East Long. 69° 55′. These united streams then turn towards the west. After throwing out many branches, the chief stream, about fifteen miles below Shikarpoor, divides into two; the largest of which pursues its course as far as Sehwaun, where it again turns to the east; and after bending again to the west it throws itself into the sea at Lahery Bunder in North Lat. 24° 22′, and 67° 23′ East Long.

This branch is navigable for large vessels about three days journey up from Lahery Bunder, viz. to Dharaja Bunder, where the goods are unloaded and put on board flat-bottomed boats, which proceed as far up as Moultan and Lahore. The most eastern branch of the river, which is called the Nulla Suncra, is said to be about a degree distant from the main stream in the parallel of Hydrabad. It formerly threw itself into the sea at Lukput Bunder, but is now said to lose itself in the sand. About twelve miles to the north of Hydrabad the Fuloolee branch separates from the main stream, but is again connected with it by an artificial cut about twenty miles below that city. This cut is seven miles long, and the part of the waters which does not flow through it into the principal stream of the Indus, falls into the sea at Lukput Bunder, under the name of Goonee. This branch has begun to be obstructed by shoals at Ali Bunder in North Lat. 24° 25′, and will likely be lost in the sands.

The principal stream of the Indus is said to be in general about a mile broad, and to vary in depth from two to five fathoms. The swelling of the river, arising from the melting of the snow in the Kashmere mountains, begins early in July, and continues till the end of August.

This province is about 300 miles long, and at an average about 80 miles broad. The part which lies to the westward of the limits where the monsoon ceases, is, from the want of moisture, utterly barren and unproductive. To the east of the meridian of 67° 40′, the land near the Indus is capable of the highest improvement; and the banks of the river, from being annually overflowed, equal in fertility and richness the borders of the Nile. The country is in general in a state of culture for about thirty-five miles on each side of the river, but to the northward of Tatta and even Sehwaun, the country is mountainous, poorer, and thinly inhabited.

The land on the banks of the river is irrigated by means of canals and drains, from which the water is often raised to the requisite level by means of wheels. One wheel is capable of watering sixteen beegahs of land, and every beegah thus watered, pays a revenue of from 1¼ to 3½ rupees to the government. A tax of one rupee is likewise levied upon every khunwar (eighty pounds) of grain produced by the farmer. The grains and other seeds are raised during the swelling of the river, and the rest of the year is employed in the raising of indigo, sugar-canes, huldee, &c. Land cultivated for gardens and producing fruit trees, pays a tax of 2½ rupees per beegah, and the spring crop of tobacco pays 4½ rupees per beegah. The land revenue on sugar is about 4½ rupees per beegah and is drawn in kind. So enormous are the exactions of the government that the sum of all the duties and customs often exceeds the prime cost of the commodities. These duties are farmed to individuals, who are generally removed every year.

The chief articles of domestic produce exported from this province are rice, glue, hides, shark-fins potash, saltpetre, assafœtida, bdellium, madder, frankincense, Tatta-cloths, horses, indigo, oil of sesamum, mujeet sirshif oil, raisins, almonds, colouring plants, pistachio flowers and nuts, shawls, cloths, mustard, wild saffron, black cummin seed from Kerman, white cummin seed, and chintzes both from Scinde and Khorasan. A great part of these articles are sent to Bombay. The articles imported into Scinde from Bombay are white sugar, sugar-candy, steel, iron, tin, tutenague, lead, cochineal, betel-nut, black pepper, dried cocoanuts, vermillion, red lead, quicksilver, Bengal and China silks and cloths, cinnamon, cardamoms, cloves, nutmeg, sandal wool, ginger, china ware, pearls, aloes, and amuttas. Scinde imports swords and carpets from Khorasan and Kandahar, silk and other articles from the Persian Gulf, and alum, musk, and horses from Moultan; cotton, snuff, unwrought iron, and the small Arabian aloe from Kutch. The principal traders are the Mooltany merchants settled in Scinde. The East India Company had formerly a factory in Scinde, and carried on a considerable trade, but it was abandoned; and a subsequent attempt made by the Company of Bombay to renew the trade also failed.

Since the accession of the present rapacious rulers of Scinde, the trade and agriculture of the province have greatly declined. Being addicted to hunting, they have converted into wastes and jungles, for the preservation of their game, extensive tracts of the best land on the banks of the Indus.

The government is a military despotism, vested in three brothers of the Talpoony (Talpore) family. These ameers belong to the Mahommedan sect of sheeas, but they are very tolerant. The Mahommedan inhabitants compose the army, which consists of forty-two tribes who hold the land by a military tenure, and are obliged when called upon to furnish a certain number of cavalry. By this means the ameer can bring into the field an army of 36,000 irregular cavalry, who sometimes dismount and fight on foot.

The revenues of Scinde are now forty-two lacks of rupees, having been formerly eighty lacks during the Calorie government. The principal towns of Scinde are Hyderabad, the capital, and the residence of the ameers, Tatta, Corachie, or Crotchey,* Gugah, and Amercote.

Hyderabad. Hyderabad, situated in north lat. 25° 22′, and east long. 68° 41′ stands on a rocky eminence, the base of which is washed by the Fuloolee branch of the Indus. It is of an irregular hexagonal form, accommodated to the mass of rock on which it is built. It is surrounded with a high brick wall, perforated with loop holes, and flanked with round towers. The sides of the hill are in many places so steep, that it would be difficult to ascend even if the walls were breached to their foundation. The weakest part is towards the south-east, opposite a creek in the Fuloolee, which approaches within a few yards of the wall. On the north side is a dry ditch hewn out of the rock, over which there is a bridge opposite to the gate, near the suburb. Within the fort are several handsome mosques, but in the vicinity there are no buildings deserving of notice excepting the tomb of Gholaum Shah, the founder of the city, which stands on a hill to the south of the fort. Although the ameers hold out no encouragement to industry, yet the city contains many skilful artisans, particularly armourers and embroiderers on leather. This city yields a revenue of 60,000 rupees. About two and a half miles to the south of the city is a table land extending about two miles, and about twelve miles to the southward is a range of rocky hills called the Gungah hills. The population of Hyderabad is about 15,000.

Tatta. Tatta, supposed to be the ancient *Pattala*, is situated four miles to the west of the Indus, and by the course of the river about 130 miles from the sea. Before the building of Hyderabad it was regarded as the chief city of Scinde. The town stands in a valley formed by a range of low rocky hills, and which is inundated during the rising of the Indus; but being built on an eminence, apparently formed by ancient ruins, it has the appearance of an island when the rains are at their height. The town is about four miles and a half in circumference, and was formerly defended by a strong brick wall now in ruins. The streets are narrow and dirty, and the houses, though irregularly coconstructed of mud, chopped straw and wood, are superior to the low huts commonly seen in the native towns. The better sort of houses are built of brick and lime. The old English factory, bought by the company in 1751, is reckoned the best house in the whole province. To the southward of it within the town are the remains of the old fort, which is strongly situated. The remains of the mosques and other handsome edifices in this city are marks of its former prosperity.

The country about Tatta has a fine rich soil, watered by canals from the Indus. About a mile to the west of the town, on the hill of Muckalee, are a great number of graves and mausoleums, which exceed in number the abodes of the living. The tomb of Mirza Eesau is a specimen of fine workmanship, and reremarkably magnificent. It consists of a large square stone building, two storeys high, and sustained by numerous columns, which, as well as the body of the building, are covered with sentences from the Koran. On the banks of the Indus there is another hill about seven miles above Tatta, covered with white mosques and Mahommedan tombs. Near one of the smallest, which the Mahommedans highly venerate, there is a bone sticking upright in the earth, 18 feet long, one foot thick and two broad. The distance of Tatta from Bombay is 741 miles, and from Calcutta 1602. The population of Tatta is about 18,000.

Gugah. Gugah is built at the foot of a hill, at the bottom of which runs a small creek. It is a place of very little trade, but sheep and fowls can be procured at a moderate rate. The hill on which Gugah stands is bounded on the south and west by a dry nullah, on the bed of which is a large tank of fine water. Gugah contains 600 inhabitants, and is situated in East Long. 68° 7′, and North Lat. 54° 24′.

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* See our article CROTCHEY, Vol. VII. p. 371.

The extensive ruins of Bamborah are situated in East Long. 67° 50′, and North Lat. 24° 46′, and are supposed to be the remains of the ancient city of Brahminabad. In the neighbourhood are many tombs of Scindyan warriors, who fell in a battle fought between Gholaum Shah and Meer Ali.

Amercote, the retreat of Humaioom, once belonged to Scinde, but is now in the possession of the Rajah of Joudpore. This fort lies south-east of Hyderabad, and is about twenty-five miles only from the eastern branch of the Indus. It is situated in East Long. 70° 24′, and North Lat. 26° 23′, (68° 17′ east, and 24° 41′ north, according to Kinneir.) The country around it is so dry and barren, that it has not sufficient land revenue to support a small local military corps. In the vicinity of Amercote is the principal fortress belonging to the chief ameer of Scinde, in which his treasures are supposed to be lodged. It is built on a hill in the desert, and contains excellent wells, although there is no water within four stages of it. For farther information respecting this province, see Hamilton's *East India Gazetteer*, articles SCINDE and TATTA, and Macdonald Kinneir's *Memoir of the Persian Empire*, p. 226—234.

SCIO, *the Chios* of the ancients, is an island of the Grecian archipelago, about thirty miles long, and having a variable breadth of from ten to eighteen miles. It is separated from Asia Minor by a strait about nine miles wide. The island consists of huge mountains which are in many places rugged and rocky; but the most part of it is less elevated and uneven. The plain which surrounds the capital is remarkable for its beauty and fertility. It is covered with country houses and gardens filled with orange and lemon trees. In the whole of the south part of the island the lands are every where susceptible of cultivation. The island contains sixty-eight villages all inhabited by Greeks. About twenty-four of these, which furnish mastic are the most wealthy and populous. The principal ones are Pirghi, Ninita, Calamoti, Calcinatia, Volisso, &c. Almost all the villages are well built and have an enclosure capable of defending them against a coup-de-main from corsairs.

The island is watered only by a few streams or rather mountain torrents, but good springs are numerous, and water can always be obtained by sinking a well.

Although the land in general is well cultivated and greatly improved, yet the corn raised is not nearly sufficient for the support of the inhabitants. Wheat and barley are their principal crop, but the wheat is not sufficient to subsist them more than three months. The wine, which in general is sweet and strong, is sufficient for the consumption of seven or eight months. Oil is raised in such abundance as to supply all their wants in this respect, but when the crops fail they procure it from Mitylene.

The pasturage on the island is very scanty, and its place is supplied by the cotton shrubs after the cotton is gathered, and by the dried leaves of the vine in winter. Here animal food is very scarce and expensive, with the exception of goat's flesh.

One of the most important productions of the island, and almost peculiar to it is *mastic*, with which it supplies Constantinople. The shrub (the lentisk) is about fifteen feet high, and grows on the face of the hills bearing a small red berry.* Early in July the rhind is punctured with an awl, and in three days the gum begins to flow upon the ground which is made hard and smooth to receive it. In eight days it is sufficiently indurated to be lifted. All the villages that prepare the mastic enjoy peculiar privileges. A very good and agreeable brandy is made here from mastic. The turpentine of Scio, which is much valued, is daily becoming more scarce. The cotton raised is not sufficient for the demand, and they are obliged to import a great quantity of raw silk, although the rearing of silkworms is an occupation almost general at Scio.

Oranges, common and wild lemons, and Bergamot citrons are exported in great quantities to Constantinople, Adrianople, and Smyrna, to the annual amount of £80,000 sterling. From the rose tree is manufactured the conserve of roses, and also the essential oil. Dried figs are exported to the amount of £4000 sterling annually.

From the oval fruit of the sebesten, which is a little less than the common olive, is obtained an excellent glue, which is used for birdcatching throughout the Levant. Among the other articles of export from Scio are the dried plums from the plum tree called the Verdassier, and the galls of a species of willow (salvia pomifera.) The mulberry is also cultivated.

Among the articles imported into Scio are wheat, wax, honey for the syrups preserves and sweetmeats which they manufacture, and wine from Ipsara and Mycone.

It has been calculated that 500 looms are employed in the manufacture of silk stuffs. Though the inhabitants have been able to imitate the Lyons silk stuffs, yet they have succeeded better with the India silks and cottons. They likewise manufacture *gaitans* or silk loops used for the edging and button-holes of the Turkish dresses, and they also plait some in gold and in silver for the female dresses. The annual value of the various cloths manufactured at Scio is about £250,000 sterling.

The revenue of the island arises from the custom-house duties, from a small rent paid for lands, and from the karatch or capitation tax upon males above the age of puberty. The first class of males pays 11 piastres, the second 5½, and the third 2¾.

The Greeks are said to have 700 churches in the island, and the priests are proportionally numerous. The Latins have only four churches, one in the town, and three in the country. The inhabitants of the mastic villages are permitted to have bells to their churches.

The following is the population of the island according to different authors:

Pococke	100,000
Olivier	110,000
Turner	150,000
Hassel's Tables (1824) .	100,000

According to Turner there are not more than 400 Turks in the island. There are several small islands round Scio. About two leagues to the west of Cape Nicola is Ipsara with a single house on the ruins of the ancient Psyra. Anti-Ipsara a league from this, is a desert island, about two leagues in circuit. Nearer and to the east of Scio are some islets called Spalmadon. See Olivier's *Voyage dans l'Empire Ottoman*, Tome I. chap. xxvi. p. 276, and Sonnini's *Travels in Greece and Turkey*, chap. xxxvii. p. 482.

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* This shrub furnishes the best toothpicks, to the fancy of the Roman Ladies.

Scio
||
Sclavonia.

SCIO, the capital of the island of the same name, is situated on its eastern coast. It is built at the foot of the mountains on which the old town or Palaio Castro stood. The streets though narrow are always paved and tolerably clean. Many of the houses are handsome, and all of them are high, and are built of stone and brick. A hard reddish sandstone, of a fine grain, is employed for the lintels and rybats, and for the porches of churches, &c. In the centre of the houses it is customary to have a lofty and spacious apartment, to which the members resort in sultry weather during the heat of noon.

The castle, which is a large Venetian fort, was used as a sort of state prison for Constantinople; but it is now in a ruinous condition. The fortifications though regular are ancient, and with the exception of those on the battery, which defends the entrance to the harbour, the guns are without carriages. There is a good road for large vessels, but the harbour which is sheltered by a mole, can receive vessels only when they are unloaded.

The Lazaretto stands to the north of the town, in an extensive inclosure towards the sea. It consists of various piles of building separated from one another, some intended for the sick, and others for the convalescent. There is also an hospital for lepers, situated to the N.N.W. of the town, in a narrow valley, which is under the direction of two intendants of health, elected annually for the purpose of taking charge of it and the Lazaretto.

On the west and north-west, the town is surrounded by arid schistose and granitic hills. Population, according to Mr. Turner, 35,000. East Long. 25° 54′. North Lat. 38° 23′ 27″.

SCIOTO, the name of a county, a township, and a river in the United States. The county is bounded on the south by the Ohio, on the east by Gallia, on the north by Ross and Pike, and on the west by Adams. It contains nine counties, and a population of 3399. The hills near the Ohio are covered with white oak and hickory, and are suitable to pasturage and wheat. Turkey and Pine creeks have many fine situations for mills which are but partially improved. Portsmouth is the principal town of the county.

The Scioto river rises near 40° 30′ of North Lat. not far from the Round-heads' Indian town, and flowing through Great Prairie, takes an eastern direction to below the Sandusky plains, whence it runs south through the middle of the state of Ohio, irrigating some of the most fertile lands, and falling into the Ohio in North Lat. 38° 34′. It is navigable by large barges for 200 miles, with a portage of only four miles to the Sandusky. Through the Sandusky and Scioto lies the most common pass from Canada to the Ohio and Mississippi, one of the most useful and extensive communications that exist in any country. The Scioto flows with a gentle current, which is nowhere broken by falls. It has three considerable western branches, Paint, Deer, and Darby's creeks; and on the east Big Belly and Whetstone Creek. The Little Scioto river is a small stream, which falls into the Ohio eastward, and twenty miles below the Scioto.

SCIPIO. See Carthage and Rome.

SCLAVONIA. One of the southern provinces of the Austrian empire. It is long and narrow, but widening towards the west. It is separated from Hungary on the north, by the Drave and by the Danube after it receives the Drave. On the south it is separated from Bavaria in Turkey by the Save, a large river which falls into the Danube at Belgrade, the most eastern point of Sclavonia.

Sclavonia contains the regimental districts of Peterwaradin, Brod and Gradisca. It is about 150 miles long, and its breadth varies from 25 to 45 miles. Its area is about 6600 square miles, and its population is about 530,000.

A chain of high mountains extends along the whole length of Sclavonia. These mountains descend into fertile plains on the banks of the Drave, the Danube, and the Save. The mountains are covered with forests containing the finest oaks, while the plains produce wheat, barley, maize, flax, hemp, and madder. The fruits of a warm climate are here abundant. Cattle and sheep though numerous are not much attended to. Among the wild animals are the wolf, the boar, the fox, and the vulture. The prevailing minerals are limestone, sulphur, coal, salt, and some iron.

The inhabitants belong chiefly to the Greek church. There is a considerable number of Catholics, but no Lutherans.

Manufactures are here in a very low state, and even the soil is cultivated in a slovenly and ignorant manner. Corn, tobacco, hides, wax, honey, and madder are exported in small quantities. The imports are iron, salt, and oil.

The condition of the people has improved since the country came under the dominion of Austria. Some of the public roads are improved, and it is probable that greater advances will soon be made in civilizing the people and ameliorating their condition.

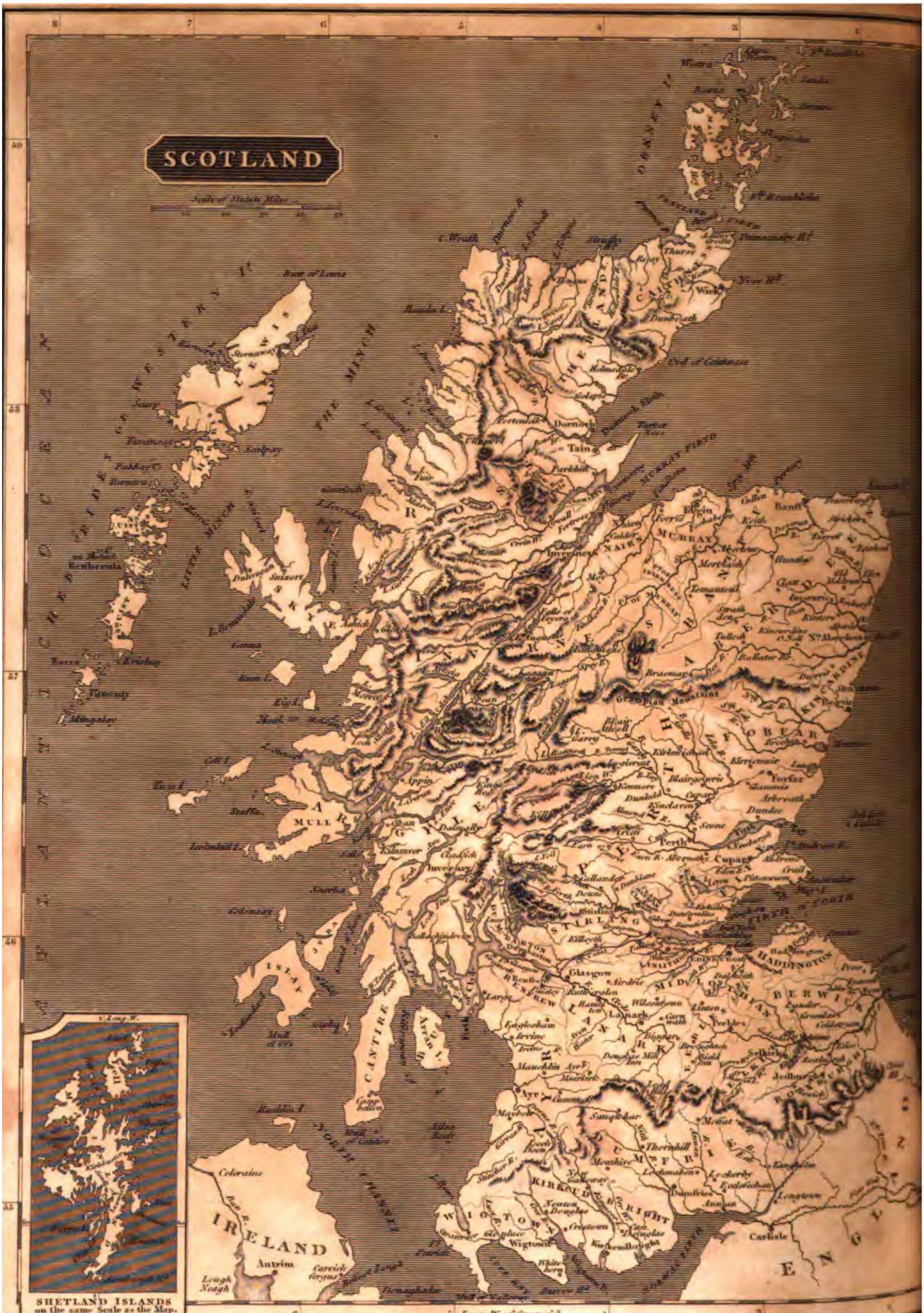
SCOMBER. See Ichthyology.

SCONE, the name of a village and parish of Scotland, in the county of Perth. It is situated on the banks of the Tay above Perth. The remains of the palace of Scone, once the residence of our kings, and the place of their coronation, are incorporated with a large and elegant modern mansion recently erected by the Earl of Mansfield. It is built of red freestone, and stands in a fine lawn on the northern bank of the Tay. The population of the parish in 1821 was 2155, being an increase of 202 since 1811, in consequence partly of the establishment of a bleach field.

SCOPELO, Scopoli, the *Scopelos* of the ancients, is the chief of a group of islands situated near the coast of Greece. These islands are Pelagnesi, Serakino, Dromi, Skiato, &c. "Scopoli," says Sonnini, "is fertile, and would be an agreeable abode, if it ceased to lose, through the viciousness of its administration, the favours lavished on it by nature. The wine of Scopoli is still one of the best of the Archipelago; but a strong flavour of tar renders it unpalatable to many. Off the town, or rather the village, ships find a harbour which is not very safe; they in general prefer the anchorage of a great road formed by a few shoals and the island of Scopoli." The nearest of this group to the coast is Skiato, which is separated from Scopoli by a channel two leagues wide, and from the mainland by a channel not much wider. In the middle of the isle of Dromi are two or three rocks called the Brothers. Between Serakino and Scopoli a mountain rises in the midst of the waters, called St. Elias. See Sonnini's *Travels*, chap. xl. p. 535, 536.

SCORPIO. See Astronomy, Vol. I. p. 768.

SCOTIA Nova. See Nova Scotia.



Drawn & Engraved by W.H. Lizars for the Edinburgh Encyclopaedia.

SCOTLAND.

PART I. HISTORY.

The early history of Scotland, like that of all other countries, and like that of Britain in general, is lost in obscurity. Hence fable has as usual been substituted for reality, and hence we have not been without the appearance at least of an early history. That these fables have received the sanction of Buchanan, is not a reason why they should longer be repeated. It remained for Hailes, in our own day, and for Chalmers, still later, to clear up such of these obscurities as admitted of arrangement and illumination, to reject fable, and to add from authentic and new documents, much that had been neglected and forgotten by those who were more desirous to construct a continued narrative, than willing to search for what was difficult of attainment. In this narrow sketch we must not only reject much of what used formerly to pass for history, but must even condense into a dry and meagre chronicle, that which, better treated, would be utterly incompatible with our limits.

From the number of our Celtic topographical names, from our possessing a living dialect of this ancient language, and from the general knowledge of the Celtic migrations, we have reason to believe that the first population of Scotland, as of England, was a Celtic race, of which we still possess the remains. But, at a very early period, the doubtful and disputed date of which lies probably about the first and second centuries before Christ, a Gothic race, known by the name of Pets, or Picts, settled in Scotland, occupying entirely the northern islands, and probably establishing themselves by the conquest of the original Celts, as the Danes and Ostmen in general did, in after-times, in Britain and Ireland generally. That they were, in fact, the very same people, the progenitors of those whose invasions and conquests were so often repeated in after-times, seems almost proved; and hence did the low country of Scotland derive its Saxon, or rather Danish language, the very language which it possesses to this day.

That these were the Caledonians who so long and successfully resisted the Romans, is proved, partly by their geographical position, but most unquestionably by the evidence of Tacitus, who describes their tall stature, light hair, and blue eyes, and who adds that their German origin is thus evinced. It is well known that the Celts, on the other hand, were a small and dark people, with black eyes and hair.

Henceforward we have no knowledge, we cannot even form a conjecture respecting the state and history of Caledonia till the arrival of the Romans; and the little which we thus possess, we must borrow from Roman history. It was in the year 75 A. D. that the Romans, who had originally invaded Britain 130 years before, first prolonged their investigations to Scotland. But it was in 78 that Agricola assumed the command in Britain, and, two years after, he entered the country with an army; repeating his campaigns for successive years, till, in 84, he extended his attack, and fought against Galgacus, the celebrated battle of the Grampians, on the borders of the mountains, and apparently near Stonehaven.

Having gained a victory, and accepted hostages, his fleet circumnavigated Scotland; and the result of their discoveries is embodied in the ancient Geography of Ptolemy and others. But, in 85, he was removed and recalled; and henceforward there is a long period of silence and darkness until the visit of Adrian.

Adrian. A. D. 121.

The Emperor Adrian visited Britain to correct abuses and restore tranquillity. The better to secure the frontiers, he built a rampart between the Firth of Solway and the river Tyne; providing a security against the attacks of the refractory tribes in the South, who could not be restrained by the military posts between the Firths of Forth and Clyde.

A. D. 138.

Antoninus. A. D. 140.

Upon the death of Adrian, Antoninus assumed the purple, and appointed as his lieutenant in Britain, Lollius Urbicus. It was during the government of Urbicus that the second Roman Wall was erected, which extended from Carron on the Forth to Dunglass upon the Clyde. Its total length was sixty-three thousand nine-hundred and eighty-yards, and this stupendous rampart was defended by nineteen forts. This wall was obviously intended to overawe the tribes that lived on the south side, as well as to repel the incursions of the northern Caledonians. The same policy which suggested the expediency of erecting such a formidable barrier along the course of Agricola's military stations, suggested also the necessity of constructing roads and fixing stations throughout the Roman territories in Britain.

The whole extent of territory that lay between the walls of Adrian and Antoninus, was everywhere intersected by Roman roads. But it is doubtful whether the country between the Northern Wall and the Murray Frith was formally erected into a Roman province; though it was traversed by roads of communication and overawed by military stations.

A. D. 161.

Lollius Urbicus was removed from the government of Britain, in consequence of the death of Antoninus Pius. So effectually had the Caledonians been restrained by his vigorous but beneficent policy, that, during his administration, and for several years after his removal, no insurrections took place. But the natives, impatient of restraint, began to manifest a disposition to revolt. Calphurnius Agricola, being sent into Britain, enforced submission and restored tranquillity. The Romans finding their conquests in Caledonia burdensome, began to contract the limits of the empire; and, during the reign of the Emperor Aurelian, evacuated the military stations beyond the Wall of Antoninus.

Commodus. A. D. 170.

During the misrule of the Emperor Commodus, the Caledonians passed the Northern Wall, and ravaged the open country; but being attacked by Marcellus, they retired to the mountains. In repelling these predatory incursions, the Romans derived neither advantage nor glory; they therefore concluded a treaty with their turbulent neighbours, in the beginning of the reign of the Emperor Severus, but the peace continued only seven years. Notwithstanding his advanced age, and his bodily infirmities, which obliged him to be transported in a litter, Severus embarked for Britain, attended by

Severus. A. D. 209.

his two sons and a formidable army. Upon his arrival he repaired or rebuilt the Wall of Adrian, in order to protect his retreat in case of accidents. He speedily passed the Northern Wall, and penetrated into the country of the Caledonians, without meeting an enemy; but the coldness of the climate, and the severity of a winter march across the hills and morasses of North Britain, are reported to have cost the Romans fifty thousand men.

Unable to oppose the obstinate attack of the Romans, the fugitive Caledonians were compelled to sue for peace, and to surrender a part of their arms and a considerable portion of their territory. The Emperor then retired beyond the Wall of Adrian, but the barbarians, regardless of the obligation of a treaty, renewed hostilities, in consequence of which Severus sent another army into their country under his son, Caracalla, with orders to extirpate them; dying at York shortly after, in the sixty-sixth year of his age.

A. D. 211.

Caracalla.

Upon the death of Severus, Caracalla concluded a treaty with the Caledonians, by which he relinquished the territories they had recently surrendered to his father; and he abandoned the forts which had been erected to enforce their submission. The Wall of Antoninus was fixed as the northern boundary of the Romans. For about a century after this period, the Caledonian tribes remained quiet; and they appear to have profited by their intercourse with their late masters; for, during this long interval of peace, they cut down woods, drained marshes, introduced agriculture, constructed, or, more probably, repaired the Roman highways, and built several towns.

From the silence of the classic authors respecting the affairs of Caledonia during the third century, it is probable that the native tribes had devoted their attention to the pursuits of peace. The long residence of the Romans in the island, had improved the rude manners of the inhabitants, taught them to desire and raise the conveniences of life, and reconciled them to their language and manners.

Of the twenty-one Caledonian tribes, sixteen lived on the north side of Antoninus's Wall. The five southern tribes, separated for a long period by an impassable barrier from the congenerous tribes of the north, felt little interest in the revolutions of the Roman world; but, in the beginning of the fourth century, they had become the objects of jealousy to the northern tribes, who made irruptions into their territories. The convulsions of the empire had probably rendered it necessary to withdraw the greater part of the troops from the Roman Wall; and thus leaving it comparatively defenceless, to invite the hostile attacks of the secluded Caledonians.

Constans.

In the year 306 Constans found it necessary to repair to Britain in person, to repel the attacks of the Caledonians. The Romans were successful, but their general died at York.

Valentinian.

In the reign of the emperor Valentinian, the Scots and Picts made a general attack upon the Roman province, and advanced as far as London, which they plundered, but being attacked by Theodosius, retreated.

The remaining transactions of the Romans in Britain were few and unimportant.

The Emperors had found it necessary to recruit their legions from the frontier provinces, where the spirit of war was not totally extinguished. These mercenary forces, careless of laws, and indifferent to civil institutions, established a military government dangerous to the authority of the sovereign, and inimical to the liberty of the people.

The barbarous nations in the north of Germany, known by the name of the Goths and Vandals, assailed the frontiers of the Roman empire; and all the distant legions in which the Emperors could confide, were recalled for the defence of the capital and the centre of the empire, which had become a prey to faction and disorder. The legions in Britain revolted, and transferred the supreme power to Gratian; and, after his death, to Constantine, who conveyed the army that had invested him with the purple, to Gaul, in order to maintain their election.

As the Roman power was weakened in Britain, the Scots and Picts advanced, and harassed the provinces. In this extremity, the latter made supplications to Rome; and a legion was sent to their assistance. This force was an overmatch for the invaders, who were overthrown in every engagement, and the Romans, for the last time, repaired the fortifications that had long overawed the British tribes. Having performed this last office, the Romans informed their allies that they must thenceforward depend upon their own valour to preserve their independence; and then took their final leave of Britain, after being masters of the greatest part of it for nearly four centuries.

Scots a Picts

But no sooner had they evacuated the island, than the Scots and Picts, regarding the country as their prey, attacked the northern wall and the adjacent country with great fury. Subdued by their own fears, the dispirited natives deserted their station, and left the country entirely open to the inroads of the victorious enemy. They addressed a letter of supplication to Rome, in which they pathetically deplored their hapless condition. "The barbarians," said they, "chase us into the sea; the sea throws us back on the barbarians, and we have only the hard choice left us of perishing by the sword or by the waves."

To these complaints the Britons received a desponding answer. Reduced to despair, they deserted their habitations, abandoned tillage, and, fleeing for shelter to their forests and mountains, suffered equally from the sword and from hunger. The invaders themselves began to feel the pressure of famine in a country which they had ravaged, and being attacked by the Saxons, whom the Britons had invited to their assistance, they retreated beyond the wall of Antoninus.

Unawed by the Romans, the Picts became the most potent people in the north of Caledonia. The five Romanized tribes assumed the character of independence, and established their own government and laws. Their territory extended from the river Eden and the Solway Frith, to the northern wall. It included Liddisdale, Tiviotdale, Dumfries, Galloway, Ayrshire, Renfrewshire, the middle and west parts of Stirlingshire, and the greater part of Dumbartonshire. Alcluyd, now Dumbarton, was the metropolis of this kingdom.

The Angles invaded it soon after the Saxons had seized South Britain. Though the Britons opposed their invaders with persevering bravery, the latter overran the country as far as the northern wall, and concluded a treaty with the Picts. The enfeebled Britons soon sunk under the superior power of the Angles; and, in the beginning of the seventh century, Ethelfrid a Northumbrian chief, entirely subdued them. Edwin, a rival contemporary, succeeded Ethelfrid.

The history of the Picts is obscure. The first Pictish monarch was Drust, the son of Erp, who for a long period rendered himself terrible to the Romanized Britons, and the series is as follows:

Galanau Etelich,	A. D. 510	522
Dadrest,	522	523
Drest, the son of Girom,	523	524
Drest, the son of W. Drest, with the former,	524	529
Drest, the son of Girom, alone,	529	534
Gartnach, the son of Girom,	534	541
Gealtraim, the son of Girom,	541	542
Talorg, the son of Muircholaich,	542	553
Drest, the son of Munait,	553	554
Galam, with Aleph,	554	555
Galam, with Bridei,	555	556
Bridei, the son of Mailcon,	556	586
Gartnaich, the son of Domelch,	586	597
Nectu, the nephew of Verb,	597	617
Cineoch, the son of Luthrin,	617	636
Garnard, the son of Wid,	636	640
Bridei, the son of Wid,	640	645
Talrore, their brother,	645	657
Taloreau, the son of Elfret,	657	661
Gertnait, the son of Dounel,	661	667
Drest, his brother,	667	674
Bridei, the son of Bili,	674	695
Taran, the son of Entifidich,	695	699
Bridei, the son of Dereli,	699	710
Nechton, the son of Dereli,	710	725
Drest and Elpin,	725	730
Ungus, the son of Urguis,	730	761
Bridei, the son of Urguis,	761	763
Ciniod, the son of Wredech,	763	775
Elpin, the son of Bridei,	775	779
Drest, the son of Talorgan,	779	784
Talorgan, the son of Ungus,	784	786
Canaul, the son of Tarla,	786	791
Constantin, the son of Urguis,	791	821
Ungus, (Hungus) the son of Urguis,	821	833
Drest, the son of Constantine, and Talorgan, the son of Withoil,	833	836
Unen, the son of Ungus,	836	839
Wrad, the son of Bargoit,	839	842
Bred,	842	843

Towards the end of the seventh century, Elfrid, the Northumbrian prince, attacked the Picts. Having crossed the Forth and the Tay, he advanced into Angus as far as Dunnichen, where he received a total defeat. Few of the Saxons escaped, and so complete was their overthrow, that the Tweed, for a short time, became the northern boundary of their principality. 710. The Picts were tempted by their success to make an irruption into Northumberland, but they sustained a defeat, and Bridei their king was slain.

After this overthrow, the Saxons of Lothian remained unmolested for a considerable period, but they gradually sank into insignificance; their capital was sacked by the Picts and Saxons, and the respite from foreign war which they subsequently enjoyed must be attributed to the intestine discord which prevailed in the Pictish and Northumbrian states.

We must now notice the Scots, of whom a colony, conducted by Fergus, an Irish chieftain, had effected a permanent settlement in Argyleshire in the year of our Lord 503. The new settlers were denominated Dalriadini, and this appellation was common to the Scots even in the time of Bede. The series of the early Scottish kings, as given by Chalmers, is as follows:

Fergus, the son of Erc,	A. D. 503	506
Domangart, the son of Fergus,	506	511
Congal, the son of Domangart,	511	535
Gauran, the son of Domangart,	535	557
Conal, the son of Comgal,	557	571
Aidan, the son of Gauran,	571	605
Oocha-vui, the son of Aidan,	605	621
Kenneth-cear, the son of Eocha-viu,	A. D. 621	621
Ferchar, the son of Eogan, the first of the race of Loarn,	621	637
Donal-breac, the son of Eocha-viu,	637	642
Conal II., the grandson of Conal I.	642	652
Dungal reigned some years with Conal.		
Donal-duin, the son of Conal,	652	665
Maolduin, the son of Conal,	665	681
Ferchar-foda, the grandson of Ferchar I.,	681	702
Eocha-rineval, the son of Domangart, and the grandson of Donal-breac,	702	705
Ainbhcealach, the son of Ferchar-fada, reigned over Loarn, from 706 to 729		
Duncha-beg, reigned over Kintire and Argail till 720,	706	733
Eocha III., the son of Eocha-rineval, reigned over Kintire and Argail from 720 to 729, and also over Loarn, from 729 to 733.		
Murdach, the son of Ainbhcealach,	733	736
Eogan, the son of Muredach,	736	739
Aodh-fin, the son of Eocha III.	739	769
Fergus, the son of Aodh-fin,	769	772
Selvach II., the son of Eogan,	772	796
Eocha-anniune IV., the son of Aodh-fin,	796	826
Dungal, the son of Silvach II.	826	833
Alpin, the son of Eocha-annuine,	833	836
Kenneth, the son of Alpin,	836	843
Kenneth Macalpin over the Scots and Picts,	843	859
Donald Macalpin,	859	863
Constantine II., the son of Kenneth,	863	881
Aodh or Hugh, the son of Kenneth,	881	882
Eocha or Achy and Grig, jointly,	882	893
Donal IV., son of Constantin,	893	904
Constantin III. the son of Aodh,	904	944
Malcolm I. the son of Donal IV.	944	953
Indulf, the son of Constantin III.	953	961
Duf, the son of Malcolm I.	961	965
Culen, the son of Induff,	965	970
Kenneth III. the son of Malcolm I.	970	994
Constantin IV. the son of Culen,	994	995
Kenneth IV. surnamed Grim, the son of Duff,	995	1003
Malcolm II. the son of Kenneth III.	1003	1033
Duncan, the grandson of Malcolm II.	1033	1039
Macbeth, the son of Finlech,	1039	1056
Lulach, the son of Gruoch and Gilcomgain	1056	1057
Malcolm-ceanmor the son of Duncan,	1057	1093
Donal-bane, the son of Duncan,	1093	1094
Duncan II. the son of Malcolm III.	1094	1094
Donal-bane again,	1094	1097

The Scottish colonists were not numerous at first; but they rapidly multiplied, as they were soon joined by kindred tribes.

In the eighth century, a civil war desolated the British kingdom, and the Scots, taking advantage of these civil discords, harassed the enfeebled Picts. At length Kenneth the Second secured his accession to the Pictish throne, and united into one kingdom the whole country north of the wall of Antoninus. Kenneth II.

There is no historical evidence that the kingdom of the Scots and Picts extended beyond the northern wall. After the settlement of the Anglo-Saxons, the princes of Northumberland possessed all the territory between the Humber and the Forth. The castle of Edinburgh, which commanded the adjacent country, continued in the hands of the Saxons till the defeat of Egfrid by the Picts, who then took possession of it. But the Saxons reconquered it soon after, and retained it till it was ceded to Indulf, king of Scotland.

The district now comprehended in Galloway was colonized from Ireland. After the subjugation of the kingdom of Alcluyd, it had its own princes and laws. For a considerable period it was independent of Scotland; but it afterwards acknowledged a feudatory dependence on that kingdom, and was at length united.

After the dissolution of the Heptarchy, Cumberland became an appendage of the Scottish crown.

Kenneth Macalpine, having united the Scots and A. D. 843.

Kenneth Macalpine. Picts under one government, became formidable to the Saxons of Lothian, whose territories he frequently invaded. His dominions were assailed on the west by the Britons of Strathclyde, who burned Dunblane. The Danish pirates, under Regner Lodbrog, made a descent upon the eastern coast, penetrated to Dunkeld, and plundered the country.

A. D. 850. Kenneth is said to have removed the relics of St. Columba from Iona to Dunkeld; and he transported the "fatal stone," the palladium of Scottish independence, from Argyllshire to Scone. He died at Forteviot, the Pictish capital, and left a son and a daughter.

A. D. 859. *Donald the Third.*—This prince succeeded his brother; and the Picts, to regain their independence, formed an alliance with the Northumbrian Saxons. In the first engagement the Saxons were defeated; in the second, the Scottish king was taken prisoner; but the former, attempting to cross the Firth of Forth, lost the half of their boats in a storm. A treaty of peace was then concluded, from which the Picts were shut out. Donald reigned only four years. He was succeeded by his nephew, Constantine the Second. A. D. 863. At the period of Constantine's accession, his country was exposed to the piratical Danes, who infested England, France, and Ireland.

Half a century had elapsed since Ireland had become the scene of conflicts with the Danes, who established themselves on its eastern shores. They invaded and pillaged the opposite coast of Scotland during the third and seventh years of Constantine's reign, and he fell in battle on the shores of the Forth.

A. D. 881. *Eth, or Hugh.*—The reign of this prince was short and turbulent. A faction, headed by Grig, rendered an appeal to the sword indispensable. Eth was wounded in battle, and died in two months after.

Grig, or Gregory, the leader of the rebellion, seized the sceptre, and chose for his colleague Eocha, king of Strathclyde, the grandson of Kenneth. But at the end of three years he and his colleague were driven from the throne. He died at his castle in Aberdeenshire, four years after his abdication.

A. D. 893. *Donald the Fourth*—Upon the deposition of Grig, Donald ascended the throne. The Danes arrived in the Tay, and marched to the vicinity of Scone, where they were met by the Scots and defeated. Nine years after, another army of Danes from Ireland invaded Scotland upon the western coast. The Scots were not long in attacking them. The Danes lost their leader, and the Scots their king, who had defended the liberties of his people during a reign of eleven years.

A. D. 904. *Constantine the Third.*—Constantine, the son of Eth, assumed the government, and, having vanquished the Danes in Strathern, procured a respite from invasion for fourteen years.

At the end of that period Reginald, a Danish chief, appeared in the Clyde with an armament, and plundered the country while the Scots were mustering their armies. On this occasion the latter were assisted by the Northumbrian Saxons, who contributed to obtain the victory, the fruits of which were enjoyed for many years.

Edward, king of England, having made pretensions of sovereignty to the southern districts of Scotland, marched with an army to the borders; but his death A. D. 934. occasioned a suspension of hostilities. His son Ethelstan, in obedience to his father's commands, entered Scotland, and wasted the country. The Scots retired to the mountains, to avoid an enemy which they were unable to resist. A peace was concluded; but it was purchased by valuable presents, and the delivery of Constantine's son as a hostage.

A general confederacy of Danish and Northumbrian freebooters united with the Scots to attack the English. A numerous fleet sailed from the Tay and the Forth, when a sanguinary engagement ensued disadvantageous to the Scots and their allies.

In the sixth year of his reign, Constantine entered into a solemn engagement with the nobles and clergy, to maintain the faith, the laws, and the discipline of the church. After a reign of forty years, he resigned his crown, and retired among the Culdees of St. Andrews, where he lived several years in religious solitude, and, on account of his piety, was promoted to the dignity of abbot of that order.

A. D *Malcolm the First.*—Malcolm, the son of Donald the Fourth, ascended the abdicated throne. The most remarkable event of his reign, was the obtaining of Cumberland from the English, on condition of maintaining the peace of the northern counties, and becoming the ally of Edmund. But Edmund was assassinated. His brother Edred, who succeeded him, required Malcolm to fulfil the conditions of the treaty, and the Scots in consequence overran the disturbed counties, and were rewarded with their plunder. Malcolm was less fortunate in settling his own kingdom. An insurrection in Murrayshire required his presence to suppress it. The chief of the insurgents was punished with death; but his sept pursued the king, who encountered them in the Mearns, and was slain in battle.

A. D *Indulf.*—Upon the demise of Malcolm, Indulf, the son of Constantine the Third, assumed the government. It was during this reign that Edinburgh was ceded by Edwy to the Scots, which, at a subsequent period, led to the cession of Lothian.

The Danes infested the shores of Buchan. They were repulsed in the first attack; but landing afterwards in Bauffshire, Indulf hastened to expel them, and was slain in the pursuit of the intruders.

A. D *Duf.*—This prince had the misfortune to be opposed by his brother Culen, who was instigated by the abbot of Dunkeld. The rival prince appealed to the sword. Duf was at first successful; but being compelled to retire to the north, was assassinated at Forres.

A. D *Culen* enjoyed but a short period the sovereignty of the kingdom, as a war with the kingdom of Strathclyde terminated in his defeat and death.

A. D *Kenneth the Third.*—The national independence of the Britons of Strathclyde was about to expire; and they were subdued by Kenneth, who added their territory to the Scottish monarchy.

Edgar, king of England, being harassed by the Danes, required Kenneth, agreeably to the treaty, to restore tranquillity. The Scots appeared, and carried off the son of the Northumbrian chief. Scarcely had they returned home, when the Danes appeared in the Tay with a numerous fleet. Kenneth engaged the enemy at Luncarty, near Perth. Having secured domestic tranquillity, Kenneth established the succession in his own family. To this may be traced the sanguinary disputes which succeeded between the families of Duf and Kenneth. The king's death was effected by the treachery of Finella, a lady of the Mearns; but she soon after expiated her crime with her blood.

A. D *Constantine the Fourth* was the son of Culen. His right of succession being disputed by Kenneth, the son of Duf, the competitors met near Perth, and Constantine finished his short reign of one year.

A. D *Kenneth the Fourth.*—Kenneth, the son of Duf, was surnamed the *Grim*. Ethelred, king of England, almost depopulated Cumberland. The English fleet attempted to circumnavigate Scotland with the view of intimidation. A treaty was concluded on the former basis of common defence. Malcolm, the son of Kenneth the Third, availed himself of the opportunity to urge his pretensions to the crown; the competitors met in Upper Stratherne, and Kenneth the Grim was mortally wounded.

03. *Malcolm the Second*.—The reign of Malcolm was vigorous; he defended his country from the attacks of the Danes and the incursions of the English. Three successive attacks were made by the former, during the first eleven years of his reign, to obtain a permanent settlement on the north-east shores of Scotland.

10. The first was at Mortlach, in Moray, where the intruders were compelled to yield to the Scots. The second descent was made on the shores of Angus. The Danes, though discouraged by defeat, made a third descent upon the coast of Buchan, near Slaines Castle; 14. but they were overthrown. At length Sueno entered into a treaty with Malcolm, by which Scotland was finally exempted from the piratical incursions of his countrymen.

Being relieved from the attacks of foreign enemies, Malcolm wrested the Lothians from the Earl of Northumberland, which was thus attached to the Scottish monarchy.

31. Malcolm died, or was asssassinated, at Glammis, in Angus.

33. The events of Duncan's reign were few and unimportant. His grandfather had slain Kenneth the Fourth, and supplanted his family. Kenneth's grand-daughter, the lady Gruach, was married, first to the maormor or chief of Moray, who was burnt, with many of his clan. Her second husband was Macbeth, who was the grandson of Malcolm the Second. Lady Macbeth assassinated the king at Bothgowanan, near Elgin, whither he had been drawn by some duty. Duncan left two sons, Malcolm who fled to England, and Donald who was chased to the Western Isles.

039. *Macbeth* was, by birth, the thane of Ross, and by his marriage thane of Moray. Supported by the lieges of Ross and Moray, and the partisans of Kenneth the Fourth, he hastened to Scone, where he was crowned king. Conscious of his defective title, he endeavoured to acquire stability by a beneficent and vigorous administration.

For ten years he reigned in apparent security. An unsuccessful effort was made by the abbot of Dunkeld to drive him from the throne, and to restore the legitimate heir. To protect himself from the nobility, he is said to have built Dunsinnan castle, exacting heavy contributions, and requiring their personal attendance.

Macduff, Thane of Fife, declined obedience, fled to England, and encouraged Malcolm to assert his right to the crown of his ancestors. Siward, Earl of Northumberland, having received the command of 10,000 men from the English king, marched into Scotland and defeated Macbeth, who fled to the north, resolving still to contend for the sovereignty; but he was slain in battle the following year by the hand of Macduff.

Lulach, lady Macbeth's son, was acknowledged king by the lieges of Ross and Moray. But Malcolm discovered his lurking-place, and slew him in Strathbogie. Macbeth and Lulach were buried in Iona.

1057. *Malcolm the Third*, surnamed Canmore, was induced to cultivate peace with England, until the death of Edward the Confessor. Harold, the last prince of the Saxon line, succeeded; but he was opposed by his brother Tostig, who, aided by a body of Norwegians, invaded England. The intruder was repulsed, and fled to Scotland, where he obtained an asylum. But in a second attempt upon England, he and his confederate, Harold king of Norway, were slain at the battle of Staneford Bridge.

A.D. 1066. The alliance between Scotland and England was superseded by the victory and accession of *William the Conqueror*. Edgar Atheling, the heir of the Saxon line, was supported by the malcontent lords, who fled with him and his family to Scotland, and sought the protection of Malcolm, who soon after espoused Margaret, the sister of the fugitive prince.

A formidable attack was meditated against England by the adherents of Atheling, in conjunction with the Danes and Scots. The Saxons and Danes made a descent upon Yorkshire. The Conqueror had the address to dissolve the confederacy. Edgar and his adherents found safety in flight and concealment. Malcolm, when too late, led his forces into England by the western borders, and wasted and pillaged the country.

Gospatrick, a Northumbrian chief, who had deserted Atheling, retaliated upon Malcolm's subjects in Cumberland; and the latter commanded his army to sieze all the young men and women in the counties through which they passed, and carry them captive into Scotland. To punish the late revolt, William the Conqueror laid waste the country between the Humber and the Tees, and invaded Scotland.

A.D. 1072. The Scots advanced to meet him; but a convention being agreed on, Malcolm gave hostages, and did homage for the lands which he held in England.

A lapse of seven years succeeded; and Malcolm availed himself of William's absence on the Continent, to invade Northumberland. An English army under Robert advanced upon Scotland, but was compelled to make a retreat. With the view of obstructing the incursions of the Scots, William erected Newcastle.

A.D. 1080. William was succeeded by William Rufus, who released Duncan, and conferred the honour of knighthood upon him. To recover possession of his English territories, Malcolm penetrated into England as far as Newcastle. Having there received intelligence that an army was forming to arrest his progress, he retired.

Rufus, in retaliation, prepared an army for the invasion of Scotland; but a peace was concluded by the mediation of Robert, Duke of Normandy, and Edgar Atheling. Malcolm promised the same duty that he had yielded to the Conqueror; and William in return gave him a compensation for the lands he claimed in England.

But the peace was not of long continuance; and a disagreement having arisen about the late treaty, the king of Scots assembled a tumultuary army, burst into Northumberland, and renewed the miseries of that province. A.D. 1093. In attempting to possess himself of the castle of Alnwick, he and his eldest son were slain. The army immediately retreated, and the remains of Malcolm were interred. His queen survived him only a few days. He had nine children: Duncan the eldest was illegitimate; the remaining six sons and daughters were born to him by Margaret.

A great change was introduced into the manners of that nation during this reign. Malcolm had passed his youth at the English court. He married an Anglo-Saxon princess; and appeared in public with a state and retinue previously unknown in Scotland, while the queen introduced a degree of politeness into her court, remarkable for that age, and contributed to soften the rude manners of the nobility.

A.D. 1094. *Donald Bane and Duncan.*—At the death of Malcolm, all his children were under age. His brother Donald had taken refuge in the Hebrides, after Macbeth's usurpation, and having assembled a powerful armament in the western isles, he invaded Scotland, and ascended the throne. Duncan, the illegitimate son of Malcolm, was in the service of Rufus when these events happened, obtained his permission to invade Scotland, and expelled the usurper. No sooner had Duncan assumed the sovereign authority, than a conspiracy was formed against him by his brother Edmund and the fugitive Donald.

At their instigation, Malpedir, Earl of Mearns, assassinated Duncan. Donald Bane reascended the throne, but Edmund was condemned to perpetual imprisonment. William Rufus gave the command of an army to Edgar Atheling, who marched into Scotland, and placed Edgar the son of Malcolm upon the throne of his ancestors. Donald was imprisoned and deprived of his eyes.

A.D. 1098. *Edgar.*—The reign of this prince is not distinguished by any memorable event, and he maintained peace with England during his administration of ten years. The amicable relation between the kingdoms was strengthened by the marriage of Matilda, Edgar's sister, with Henry, (Beauclerc) king of England.

A.D. 1106. *Alexander the First.*—Alexander succeeded his brother Edgar, and married Sibilla, Henry's natural daughter; David, the youngest son of Malcolm Canmore, was put in possession of Cumberland agreeably to a testamentary deed of the late king.

Alexander was called into the northern provinces to quell an insurrection excited by Angus, the grandson of Lulach, who claimed the crown. Angus made submission, and tranquillity was restored. Alexander died at Stirling and left no legitimate issue.

A.D. 1124. *David.*—David, the youngest son of Malcolm, succeeded his brother. His reign forms an epoch in the history and jurisprudence of Scotland. By attending the English court, he acquired a knowledge of the laws of that kingdom and experience in the art of government. He married the widow of the Earl of Northampton.

With the view of securing the crown to his daughter Matilda, in defect of his own issue male, the king of England engaged the king of Scots, the English clergy and nobility, with Stephen Earl of Montainge and Bretagne, to guarantee this settlement. By this engagement, David was involved in protracted negotiations, which eventually entailed war upon both kingdoms.

A.D. 1130. Angus, Earl of Moray attempted again to overturn the government. In suppressing this insurrection, David was assisted by Walter L'Espee. The insurgents were defeated at Strickathro' in Forfarshire.

The death of Henry of England was the signal for a civil war in that kingdom. Stephen seized the throne, notwithstanding his solemn engagement to support the claim of Matilda. The king of Scots invaded England. The hostile monarchs entered into an insincere treaty; but the war was rekindled with animosity, and continued to rage for two years.

A.D. 1138. The battle of the standard was fought on Cutton Moor near Northallerton. The English formed a compact body, with the standard in the centre. The Scots were ranged in three divisions. The Scottish infantry were badly armed; their swords were brittle, and their only implement of defence was a target of leather.

The Bishop of Orkney exhorted the English to battle; he promised them victory, and absolved all who should fall in the cause of their country. The venerable Walter L'Espee ascended the carriage to which the standard was fixed, and harangued the multitude. The shock was bloody, and continued two hours. Symptoms of general disorder began to appear; when the Prince of Scotland attacked and dispersed the troops that guarded the rear. The Gallowaymen rallied, and at that moment, an English soldier cutting off the head of one of the slain, raised it, and cried, "The head of the king of Scots."

Consternation spread through the Scottish army, and the Scottish nobles compelled the king to retreat. After their defeat, the Scots turned their weapons against each other. The king interposed his authority, and to give them employment, led them to the siege of Werk, when a treaty of peace was negotiated between the hostile kings by the papal legate.

David ratified the peace concluded at Durham. The Prince of Scotland was gratified with the earldom of Northumberland, on condition that he should do homage as an English baron. The authority of Stephen was at this time established; but he alienated the affections of the clergy, and reinvolved the nation in war. Matilda being seated on the throne, invited her uncle the king of Scots to her court; but the English deposed her, and obliged her to fly, accompanied by her royal kinsman.

From that time David relinquished all concern in the affairs of England, and turned his attention to the government of his own kingdom. An Englishman named Wimund, of obscure birth, was promoted to the see of Man. Pretending to be the son of Angus, earl of Moray, he collected a number of associates, and made piratical incursions in the Western Islands. He obtained for his wife, a daughter of Somerled, Thane of Argyll, invaded Scotland, pillaged the country, and slew the inhabitants. But his people conspired against him, put out his eyes, and delivered him over to the government, by which he was imprisoned for life in Roxburgh castle.

During the course of his administration, David established towns, promoted agriculture, manufactures, and commerce, and instituted the municipal laws, known by the name of Leges Burgorum. He expired in the seventy-third year of his age.

Malcolm the Fourth, styled the Maiden, succeeded his grandfather. Upon the death of his father, Malcolm had been sent on a progress through Scotland, and proclaimed heir to the crown. He was only twelve years of age when he ascended the throne. His accession was no sooner announced, than Somerled Thane of Argyll excited an insurrection. The events of this war are unknown, but Somerled at length agreed to terms of accommodation, and kept the peace during seven years.

Upon the death of Stephen, Henry the Second succeeded to the throne of England, and demanded the restitution of those territories which the king of Scots held in England. The kings had an interview at Chester. Prudence induced Malcolm to relinquish what he could not defend. The king of Scots did homage in the same form that his grandfather had done to Henry the First, "reserving all his dignities," and Henry in return conferred on him the honour of Huntingdon.

Ambitious of receiving the order of knighthood from Henry, Malcolm repaired to the English court at Carlisle. Henry refused the expected favour, and the young prince passed over to France, where he fought under the banners of Henry, who rewarded him with the honour of which he was ambitious.

60. An insurrection in Galloway enabled Malcolm to employ his factious nobles, and to conciliate the affections of his people by the display of his valour. He invaded that province twice without success; but in a third and more successful effort, he overcame his enemies in battle, and constrained them to implore peace.

61. The inhabitants of Moray had often rebelled, and, in consequence, Malcolm dispossessed them, scattered them over Scotland, and planted new colonies in their room.

64. Somerled again invaded Scotland, and landed at Renfrew. The inhabitants repulsed his army, and the chief with his eldest son fell in battle. Malcolm died at Jedburgh.

65. *William, the Lion.*—In order to obtain the county of Northumberland, bequeathed to him by David, William repaired to the court of Henry, hoping that a personal interview would bring the negotiation to a speedy termination, whence he passed over into France, served under the English banners, and was amused with promises.

68. Indignant at Henry's insincerity, he sent ambassadors to France, and concluded a treaty with that kingdom against England. This is the first authentic evidence of the intercourse between France and Scotland.

73. William having failed in obtaining what he had no good reason to expect, left England. The prince of Wales persuaded William to join him in a confederacy against his father, and promised him the earldom of Northumberland; and to his brother David, the earldom of Cambridge. William invaded England, but failed in his attempts on Werk and Carlisle. The English crossed the Tweed, and wasted the southern counties of Scotland.

The Scots were more unfortunate in a second invasion. Having advanced as far as Alnwick, William imprudently weakened his army; and the Yorkshire barons hastened to the aid of their neighbours. Ralph de Glanville, with a band of about four hundred horsemen, approached the Scottish camp unobserved. William mistook them for a party of his own stragglers returning loaded with spoil; but the display of the English banners soon undeceived him. Perceiving his error, he charged the enemy, but was dismounted in the first shock, and was conducted to
74. Newcastle; being afterwards sent to Normandy to be exhibited as a trophy of Henry's fortune. He continued in captivity only a few months; but purchased his liberty with the independence of his country, and became Henry's liegeman for Scotland, and for all his other territories.

For the performance of this treaty, William consented to deliver up the castles of Roxburgh, Berwick, Jedburgh, Edinburgh and Stirling; and gave his brother David, and many of his chief barons as hostages.
75. He also, during the succeeding year, with the clergy and barons, did homage to Henry at York.

A dispute between the English and Scottish ecclesiastics succeeded. William and the Pope became parties in this quarrel; and though his holiness laid the kingdom under an interdict, the Scottish king and clergy remained inflexible. At this crisis, the Pope died; and his successor, Lucius the Third, reversed the sentence of excommunication. The captivity of William, with his principal ministers, was the signal for kindling a civil war in Galloway. Gilbert, one of the chief, murdered his brother that he might rule without a competitor; but entreated the protection of Henry of England, offering to pay him a yearly tribute.

The king led an army into Galloway; but instead of executing justice, he contented himself with a pecuniary satisfaction. Gilbert renewed his depredations; and William, dreading his power, offered a treaty which was refused. William married Irmangarder, daughter of Richard, Viscount of Beaumont, and received as her dower the castle of Edinburgh, the feudal service of forty knights, and a yearly revenue of a hundred pounds. A.D. 1186.

Donald Bane infested the north; and pretending a title to the crown, seized Ross and Moray, but was slain at Inverness. The bishop of Durham was deputed by Henry to levy a contribution in Scotland for the Holy War; and the restitution of the castles of Roxburgh and Berwick was offered to William to induce his compliance. The Scottish barons and clergy assembled in Parliament, considering this demand as an insult, refused their assents. A.D. 1187.

Henry the Second died, and was succeeded by his son Richard, (Cœur de Lion) who restored Scotland to its independence. For this, William agreed to pay 10,000 merks sterling. After this transaction, there was no national war between the kingdoms for more than a century. A.D. 1189.

David, earl of Huntingdon, the king's brother, accompanied Richard to the Holy land. Upon his return, he was nearly shipwrecked upon the east coast of Scotland, and founded a monastery at Lindores in Fife.

Harold, earl of Orkney and Caithness, having rebelled, William attacked his forces and defeated them. Upon the departure of the royal army, the refractory clans again rebelled under the sons of Harold. The king seized Harold, and detained one of his sons as hostage; who, in consequence of a third rebellion, had his eyes put out, and perished in prison. A.D. 1197.

Perceiving his declining health, William assembled the barons, and they swore fealty to his infant son Alexander. A dispute occurred between William, and John, king of England, concerning a fortress on the borders; but the barons of both kingdoms interfered, and terms of peace were adjusted. John promised to demolish the castle of Tweedmouth. William agreed to pay him fifteen thousand merks; and of this sum, ten thousand were advanced by the barons, and six thousand by the boroughs. William died at Stirling, and was interred in the Abbey of Arbroath. A.D. 1201. A.D. 1214.

Alexander the Second.—Alexander succeeded his father, and was crowned at Scone in the seventeenth year of his age. An insurrection in Moray, headed by Donald Macwilliam, was quickly suppressed. A civil war between John and his barons distracted the English nations. The malcontents solicited the assistance of Alexander, and promised him the surrender of Carlisle, and the investiture of Northumberland.

The Scots advanced to Norham castle, which they besieged without success, but John desolated Yorkshire and Northumberland. His soldiers penetrated into Scotland; burned Dunbar, Haddington, the priory of Coldingham and Wick. Alexander wasted the western marches with fire and sword. A.D. 1215.

Lewis, the son of the king of France, landed a body of troops in England for the purpose of co-operating with the discontented English, and the Scots who had engaged to support them. The confederates had pledged themselves not to make a separate peace; but the French having suffered a defeat at Lincoln, deserted their allies. The Scots were consequently compelled to retreat, and to seek reconciliation with the see of Rome. The papal legate was appointed arbiter of the differences between the Scots and English; and the king of Scots married Joan, Henry's sister.

A. D. 1221. An insurrection in Argyll led the king thither with an army. The rebels purchased forgiveness, and gave hostages. Several of their leaders, despairing of pardon, fled from the king's resentment. About the same time, the bishop of Caithness was murdered and burnt by the men of his diocese, for exacting his A. D. 1229. tithes. Moray also again became the scene of tumult. Gillespie burned some castles, and fired Inverness. He at first successfully resisted the king; but he was afterwards defeated and slain by Buchan, the justiciary of Scotland.

The Galloway men burst into Scotland, and in leading an army against them, the king had nearly perished in a morass. The insurgents were reduced, and peace was restored. Alexander's queen having A. D. 1239. died, he married Mary, the daughter of a baron of Picardy. She bore him a son, who was named Alexander. A war was nearly kindled between the Scots A. D. 1244. and English. Alexander marched to the borders with an army of 100,000 men.

A. D. 1249. The king died in Kerrera, in the fifty-first year of his age, and the thirty-fifth of his reign, while meditating an expedition against the Norwegian power in the Western isles; and he was interred in the abbey of Melrose.

A. D. 1249 *Alexander the Third* was only eight years of age when he succeeded his father. Some of the Scottish counsellors objected against his coronation; but William Comyn, earl of Menteith, represented the danger of a delay, as the king of England had solicited a mandate from the Pope, declaring, that Alexander, being his liegeman, ought not to be anointed or crowned without his permission. On this occasion, a highland bard, dressed in a scarlet robe, repeated on his knees, in the Gælic language, the genealogy of Alexander from Fergus the first king of Scotland. The king had been betrothed, when an infant, to the princess Mar- A. D. 1251. garet of England. Their nuptials were now celebrated at York, and Alexander did homage to Henry for his English possessions. The latter insidiously demanded homage for the kingdom of Scotland; but the king replied, "that he had been invited to York to marry the princess of England, not to treat of affairs of state, and that he would not take so important a step without the concurrence of the national council."

A. D. 1256. Alexander and his queen visited London, where Henry renewed to his son-in-law the grant of the honour of Huntingdon. Another change of the regency took place. A new one, comprehending a mixture of the contending factions, was formed, which restored tranquillity. The king and queen of Scots again visited London. To calm the apprehensions of their A. D. 1260. subjects, Henry made oath that he would not, contrary to their inclination, detain either the king, the queen, or their children, should they have issue during their stay. The young queen soon after bore Alexander a daughter, who was named Margaret.

A. D. 1263. Haco, king of Norway, threatened Scotland with an invasion; to prevent which, the king of England interposed his offices. In the succeeding year, the Norwegians landed at Largo in Cunningham. The Scots attacked them. Their fleet was dispersed and shattered by a storm, and Haco having returned to Orkney, died. Magnus, the successor of Haco, consented to relinquish the Western islands with all his rights and claims, in consideration of four thousand merks, and a yearly tribute of one hundred. The Scandinavian inhabitants were allowed to leave the island, with their effects. The Orkney and Shetland remained to Norway. From this period, Alexander was employed for several years in maintaining the independence of the Scottish church against the pretensions of the Pope, and in restraining the encroachments of the clergy.

Events followed in rapid succession, which ultimately involved the nation in a civil war. Within one year, Alexander the prince of Scotland, and his sister Margaret, who had been married to Eric, king of Norway, died. The prince had no issue. Margaret left an only daughter, Margaret, commonly called the maiden of Norway.

Alexander assembled a parliament, in order to settle the succession to the crown. The nobles solemnly bound themselves to acknowledge Margaret of Norway as their sovereign, and Alexander married Joleta, daughter of the Count de Dreux. Scarcely had the nuptial festivities ceased, when the king was thrown from his horse over a precipice, and instantly killed, in the forty-fifth year of his age, and the thirty-seventh of his reign.

Margaret.—In consequence of the absence and infancy of the maiden of Norway, the parliament appointed a regency of six; the bishop of St. Andrews, with the earls of Fife and Buchan, were elected for the administration of the counties north of the Forth; while the bishop of Glasgow, John Comyn, lord of Badenoch, and James the steward of Scotland, were intrusted with the government of the districts south of that boundary. The earl of Fife was murdered; his colleague, the earl of Buchan, died; dissensions immediately arose among the remaining four, but Eric, king of Norway, interposed, and sent plenipotentiaries to treat with Edward concerning the affairs of the infant queen and her kingdom.

That monarch had already formed the project of marrying his son to the young princess, but the king of Norway hesitated to yield up his only child. Meanwhile Edward busied himself to obtain possession of the Scottish fortresses, and while the guardians of the kingdom were preparing to receive their sovereign, the prospect of an alliance between the two nations was overthrown. The young queen sailed from Norway, landed in Orkney, and died.

The progeny of Alexander was now extinct; the regency was superseded; and the tie that united England and Scotland was broken. The nation had looked to the descendants of Alexander. The families who were connected with royalty, secretly prepared to assert their several rights; the nobles formed into factions; and the nation anticipated a civil war.

An Interregnum.—The posterity of William the Lion having become extinct by the death of the princess Margaret, the right of succession reverted to David, earl of Huntingdon, and to the posterity of his daughters, Margaret, Isabella, and Adama. Margaret left one daughter, married to John Baliol, by whom she had a son of the same name; Isabella, the second sister, had a son, Robert Bruce; Adama was the mother of John Hastings.

There appeared no fewer than thirteen competitors

y. for the crown; but, of these, ten renounced their pretensions. The competition was therefore limited to Baliol, Bruce, and Hastings. Baliol was sprung from the eldest branch; Bruce was one degree nearer the common stock; Hastings alleged that the kingdom of Scotland, like many other inheritances, was divisible, and that he had a title to a third. Baliol and Bruce united against Hastings in maintaining that the kingdom was indivisible.

On the news of the queen's death, Bruce appeared at Perth with a formidable retinue. Baliol resided in England at this critical period, and Edward was chosen umpire. One hundred and four commissioners were named, whom he commanded to examine the cause deliberately, and make their report; promising that, by the ensuing spring, he would make known his determination.

Edward's conduct, however, became suddenly very suspicious. He required that all the fortresses in Scotland should be delivered into his hands; that he might present the kingdom to the claimant whose right should be recognised. This exorbitant demand was granted. The earl of Angus alone refused to surrender the castles in his custody, without a formal and particular acquittal from parliament, which he obtained.

91. An universal homage was now required; and, resolved to regulate the succession to the crown of Scotland, and ultimately to revive his own claim of feudal sovereignty, Edward desired the nobility and clergy of Scotland to meet him at Norham. The justiciary of England required their recognition of his title as lord paramount. The assembly stood motionless and silent. At length, some one had the courage to reply, "No answer can be made while the throne is vacant." "By holy Edward, whose crown it is that I wear," cried the king, "I will vindicate my just rights, or perish in the attempt."

At the adjourned conference, Bruce and Baliol, with the other expectants of royalty, assented to the claim of Edward as lord paramount of Scotland, and bound themselves to submit to his award. The competition was decided at Berwick, and Edward decreed that Baliol should have seisin of the kingdom of Scotland.

292. Baliol swore fealty to Edward in November; in ten
ing days after, was crowned at Scone, and did homage for
and. the kingdom of Scotland at Newcastle. But the lord paramount soon threw off the mask, and commanded that all appeals should be made to England. He even required king John himself, by six different summonses on trivial occasions to appear in London, but the Scot-
294. tish parliament advised him to dismiss his English attendants, and with their approbation, he concluded a treaty with Philip of France; while, to strengthen the alliance, Baliol's son married the daughter of the Count of Anjou, and the niece of Philip.

296. In consequence of this treaty, the Scots invaded Cumberland, and assaulted Carlisle, but were repulsed. Meanwhile Edward hastened to chastise his rebellious vassals. An army of 40,000 foot, and 500 horse, marched to the borders to defend the provinces that Edward was preparing to attack.

The Scots had the precaution to throw a strong garrison into Berwick, Edward assaulted it by sea and land. His fleet was burnt or disabled; but his army took and sacked the town, and put the garrison to the sword. Baliol had, by the advice of his parliament, renounced the allegiance and fealty which he had sworn to Edward. This renunciation was communicated to Edward after the capture of Berwick. He received the instrument with contempt rather than with anger, and dispatched Earl Warenne to recover the castle of Dunbar, which had been betrayed to the Scots. On the third day, the whole forces of Scotland appeared in order of battle, but they were broken and dispersed, and 20,000 were slain or captured.

History.

Abdication of Baliol.

The castles of Roxburgh, Edinburgh, and Stirling, were successively surrendered to the English. The unfortunate Baliol implored mercy. Divested of his royal ornaments, and bearing a white rod in his hand, he performed a humiliating feudal penance, acknowledged the justice of the English invasion and conquest, and resigned Scotland to his liege lord.

A.D. 1296.

After the abdication of Baliol, Edward proceeded to Elgin, and returned home, carrying with him the "fatal stone" which was conveyed to Westminster. The great seal of Baliol was broken, and he was committed to the Tower; but, in two years after, he was restored to liberty and retired to France, where he died.

The first acts of Edward's administration were moderate and politic. He held a parliament at Berwick, and received the formal submission of the clergy and laity of Scotland. Few of those who had held offices under Baliol were displaced; and he suffered the numerous jurisdictions throughout Scotland to remain with their ancient possessors. To conciliate the favour of the Scottish bishops, he granted them for ever the privilege of bequeathing their effects by will. The government of the southern districts and castles was committed to the fidelity and vigilance of Englishmen. But the internal police of the country became disorganized, contempt of government prevailed, while Edward, engrossed with other objects of ambition, neglected that which the exigency of affairs required.

Resistance of Sir William Wallace.

A.D. 1297.

At this crisis arose Sir William Wallace. He had been outlawed, and having fled, offered himself as a leader to a few companions whose desperate fortune, or hatred of the English government, had reduced them to a similar necessity. With a resolute band, he infested the English quarters. His success in these predatory expeditions attracted multitudes to be his companions in arms; of this number was Sir William Douglas. With their united forces, they attempted to surprise the English justiciary at Scone. The viceroy fled to England, and was followed by all the officers of state. Imboldened by their success, the Scots assailed the castles, surprised and put to the sword the English who came within their power. Many persons of rank openly declared for their cause. Robert Bruce the younger, after some hesitation, joined the Scottish army.

Warenne dispatched a chosen body of troops against the enemy, enfeebled by dissensions; the more prudent saved themselves by humble submission to Edward. Sir Andrew Moray of Bothwell was the only baron who adhered to Wallace, and they retired towards the north. The English meantime advanced towards Stirling. Wallace hastened to guard the passage of the Forth, and encamped near Cambuskenneth. The English general ordered his troops to cross the Forth by a wooden bridge, but scarcely had a division passed over, when Wallace attacked them, routed them, and pushed them into the river. The English burned the bridge, abandoned their baggage, and fled to Berwick. Thus Scotland was once more free; and the castles which the English had retained were immediately surrendered. Wallace then marched his army into the north of England, where the country from Carlisle to Newcastle was wasted with all the fury of revenge and rapacity.

Wallace was now invested with the title of governor of Scotland, in name of king John; and from that period the spirit of jealousy and distrust inflamed the Scottish nobles.

A.D. 1298. During these transactions, Edward was in Flanders, but upon his return to England, he summoned the Scottish barons to a parliament at York. The Scots disobeyed, and the incensed monarch advanced to the borders. A body of English, commanded by Aymer de Valloins, earl of Pembroke, landed in the north of Fife. Wallace attacked and routed them in the forest of Black Ironside. Edward now encamped between Edinburgh and Linlithgow, while the Scots assembled all their strength in the interior part of the country. Robert Bruce and John Comyn of Badenoch advanced to Falkirk at the moment that Edward had given orders to his army to make a retrograde movement towards the borders, in consequence of a mutiny among the Welsh.

Battle of Falkirk.

Edward prepared to attack them. Wallace ranged his infantry at the side of a small eminence in the neighbourhood of Falkirk. The English were divided into three lines; Edward commanded the reserve; his chief dependence was upon his cavalry, which attacked the Scottish infantry on both flanks at once. The shock was gallantly withstood, but a total route ensued. Wallace succeeded in securing his retreat with a faithful band, and burnt the town and castle of Stirling. Bruce, who had not been in the engagement, upon hearing of the defeat of his countrymen, burned the castle of Ayr, to prevent the pursuit of Edward, and then retired. After reducing Bruce's castle of Lochmaben in Annandale, the conqueror retired by the western borders. Wallace was superseded as regent by the bishop of St. Andrews, Robert Bruce, and John Comyn, who were chosen regents in the name of A.D. 1299. Baliol. They applied to the Pope and the king of France for aid. The Pope wrote to Edward, commanding him to abstain from any further attempts upon Scotland, and asserted his claim as liege lord.

A. D. 1300. Edward and his parliament were inflexible, and the pontiff judged it prudent to abate his claims; but by the mediation of France a short truce was concluded between the English and the Scots; and a second truce for one year was subsequently agreed upon. After the expiration of it, Edward sent an army into Scotland, but Comyn and Simon Fraser attacked and A.D. 1302. defeated them successively. The Pope and the king of France proved faithless allies to the Scots, and Edward, disengaged from foreign war, bent his whole A.D. 1303. force to subdue Scotland. Unable to oppose the enemy, the Scots declined meeting them, and Edward marched to the northern extremity of the kingdom, ravaging the open country, reducing the castles, and receiving the submission of the nobles.

Stirling castle was the only fortress that remained in possession of the Scots. Comyn assembled an army, and encamped on the south bank of the Forth, to make a final stand for the national liberty. Edward, having discovered a ford, crossed the river at the head of his cavalry, and the Scots fled in every direction. Bruce surrendered himself to the English warden. Comyn and his followers submitted to the conqueror. Wallace and Sir Simon Fraser were excluded from the capitulation.

By the command of Edward, a parliament assembled at St. Andrews, and sentence of outlawry was pronounced against Wallace, Fraser, and the garrison of Stirling castle. That fortress, after a defence of three months, surrendered at discretion, and Wallace was given up to the mercy of Edward. He was arraigned at Westminster as a traitor, and executed.

Edward now proceeded to make a total settlement of the government of Scotland, and for the administration of justice to the people. Sheriffs were appointed in the different districts of the kingdom, and the ancient forms were preserved. An indemnity was granted to the Scots under easy conditions, and fines were imposed upon the delinquents.

Scotland was now apparently reduced as a conquered province under the dominion of Edward. Bruce, the competitor of Baliol, had submitted to the decision of Edward. His son had served under the English banners, and in Comyn and the earl of Carrick, the factions of Baliol and Bruce may be said to have revived. Bruce had the address at first to soothe and amuse the king; but, escaping from England, he intercepted a messenger who was the bearer of letters from Comyn to the English king, advising his own immediate imprisonment or death. Bruce, therefore, repaired to Dumfries, and obtaining an interview with Comyn before the great altar in the church of the Minorities, stabbed him and fled.

The justiciaries were holding their court when this event happened. They surrendered to Bruce; and were permitted to retire out of Scotland unmolested.

Robert Bruce was crowned at Scone in the thirty-second year of his age; but he had many serious obstacles to surmount in his progress to sovereign power; yet no sooner was the royal standard displayed, than multitudes hastened to fight for their country.

When Edward was informed of the revolution in Scotland, he appointed the earl of Pembroke to be his deputy in that kingdom; and vowed that he would take vengeance on Robert Bruce. A messenger was dispatched to the Pope, complaining of the slaughter of Comyn and the violation of the sanctuary, on which he issued an order to excommunicate Bruce and his adherents.

The first enterprise of the Scots against the English was unsuccessful. Robert retired with the remains of his party into Atholl; thence to Breadalbane, where he was attacked by the lord of Lorn, who had married Comyn's aunt. The royalists were overpowered, but effected their retreat. The king and Douglas passed over Loch-Lomond, and the former, to elude the search of his enemies, crossed over to the island of Rachlin in Ireland.

The queen and daughter of Bruce were delivered to their enemies; Nigil, his brother, was condemned and executed; the earl of Athol and Sir Christopher Seton experienced a similar fate; Sir Simon Fraser was beheaded at London, and his head placed on the point of a lance, near the head of Wallace. Many other Scotchmen of inferior rank were punished capitally; and the Cardinal Legate solemnly excommunicated Bruce and his adherents at Carlisle.

At the approach of spring, Bruce secretly crossed over into the Isle of Arran, while Douglas passed into Douglasdale; and gaining possession of Douglas castle, put the English garrison to the sword.

The earl of Pembroke advanced into the west of Scotland to encounter Bruce, but the latter was victorious. Meanwhile Edward, who had wintered at Carlisle, made preparations for quelling the insurrection in Scotland; but he died as soon as he came in sight of the country, ordering that his corpse should accompany the army into Scotland, and remain unburied until it should be subdued. Edward the Second, who succeeded his father, marched into Scotland; and having advanced as far as the frontiers of Ayrshire, returned to England. Pembroke was superseded in his command as guardian of Scotland, and the earl of Richmond was appointed in his room. Bruce now made an unsuccessful attempt upon Galloway. He was more fortunate in the north of Scotland, which he overran without opposition.

306. The ensuing year, he defeated another army commanded by Buchanan and Mowbray, near Inverury in Aberdeenshire. Though then labouring under a severe disease, he led on his troops, and routed the enemy. The castle of Aberdeen was stormed, the garrison were put to the sword, and the fortifications razed. His brother Edward invaded Galloway, and subdued the country; and the Lord of Lorn was chastised for his treatment of Robert after the battle of Methven. In the mean time, by the mediation of 3.9. Philip, king of France, a truce was concluded, in which neither party was very sincere. An ill-concerted expedition was made by the English monarch. 310. He penetrated to Renfrew, but the Scots avoided the encounter, and he retired to Berwick.

311. Robert now resolved to transfer the war to England, and ravaged the county of Durham. After his return, he besieged and took the town of Perth, which was plundered and burnt. The Scots again invaded England, and desolated the county of Durham. The castles of Roxburgh and Edinburgh were taken by surprise. Many other fortresses in the southern counties were won by the Scots. With his success, the number of Bruce's partisans increased, and he invaded Cumberland, and plundered the Isle of Man.

Stirling castle was besieged by Edward Bruce, the 314. king's brother. Edward made vigorous preparations for relieving it, he ordered a fleet to be assembled for invading Scotland, and the whole force of England was ordered to meet the king at Berwick. Bruce appointed a general rendezvous of his forces at the Torwood, between Falkirk and Stirling. Their number was about 30,000, besides an undisciplined multitude of about 15,000. The Scots posted themselves at Bannockburn, about two miles from Stirling; and after a warm action, the English fled with precipitation; and Edward, pursued by Douglas with sixty horsemen, rode to Linlithgow, nor was he allowed a moment's respite until he reached Dunbar, sixty miles from the field of battle. He was there received by the earl of March, who conveyed him by sea into England. Stirling castle immediately surrendered; and Mowbray, the governor, entered into the service of Robert. Robert now conceived the opportunity favourable for settling the succession to the crown.

For this purpose, a parliament assembled at Ayr, 315. and unanimously resolved that the king's legitimate male issue should succeed to the crown agreeably to the laws of succession; that, in the event of that issue becoming extinct, the succession should devolve on his brother Edward, and descend to his legitimate male issue; and failing these, to the king's daughter Marjory.

The Irish of Ulster, dissatisfied with the English government, implored the aid of the king of the Scots, and offered to acknowledge his brother as their sovereign. But the arms of Edward Bruce were attended with little success in Ireland, and the king of Scots resolved to conduct in person a reinforcement to his aid; but their expedition was fruitless, and Robert returned home at the expence of the lives of many of his subjects. The earl of Arundel invaded the forest of Jedburgh, but was defeated by Douglas. An English fleet in the Frith of Forth, disembarked a body of troops. The earl of Fife, with five hundred men, aided by Sinclair, Bishop of Dunkeld, charged the enemy, and pursued them to their ships. A.D. 1317.

Berwick was soon after taken after a short siege, and the Scots made successive incursions into England. With the view of intimidating them, the Pope ordered his legates in England to excommunicate Bruce and his adherents, but the latter treated the pontiff's mandate with contumacy.

Edward Bruce was slain near Dundalk, and it became necessary to make new regulations with respect to the royal succession. For this purpose, a parliament assembled at Scone, and promised to assist the king in the defence of the rights and liberties of Scotland, against all persons, however eminent in power, authority, and dignity. In the event of Bruce's death without male issue, they enacted, that the right of succession should descend to Robert Stewart, the king's grandson, by his daughter Marjory. A.D. 1318.

Edward of England, having secured domestic peace, determined to regain Berwick. As the Scots could not with any probability of success attack the English camp, they determined to make a diversion in England. Randolph and Douglas entered it by the west marches; wasted Yorkshire, and defeated the archbishop of York. The news of this defeat induced the English to discontinue the siege of Berwick. Randolph and Douglas returned home, and commissioners were appointed by both nations, who concluded a treaty for two years.

A conspiracy, of which little is known, was discovered about this time, and the English monarch, having crushed his rebellious subjects, prepared to invade Scotland. The Scots meanwhile penetrated into Lancashire, and returned home loaded with booty. A.D. 1320.

Upon the approach of the English, Robert ordered all effects of value to be removed from Merse and Lothian, and retired with his army to Culross. The English advanced as far as Edinburgh without seeing an enemy; and, in their retreat, they plundered the abbeys of Holyrood and Melrose, burnt the abbey of Dryburgh, and slew many monks. The Scots in their turn invaded the enemy's country, and nearly surprised Edward at the abbey of Biland; but a treaty of peace for thirteen years suspended the calamities of war. A.D. 1322. A.D. 1323.

Edward the Second was deposed by the English parliament. His son, Edward the Third, succeeded him, and ratified the truce which his father had made. Hostilities recommenced before the extirpation of the treaty, and Randolph and Douglas invaded England with an army of 20,000 cavalry. Edward, at the head of 50,000 men, advanced to meet the enemy. After harassing his army for some time in a fruitless chase, he crossed the Tyne, but was compelled to return southwards, as the country could yield no subsistence to his troops. After being nearly surprised in his camp by the Scots, the English government was induced to think seriously of peace. As the basis of a treaty, it was proposed that the Princess Joan of England should marry David, the young prince of Scotland. The

A.D. 1326. Deposition of Edward the Second, of England.

A.D. 1327.

plenipotentiaries met at Newcastle, and drew up articles, which were ratified by a parliament at Northampton.

A.D. 1328.

In this treaty, Edward renounced all claims of superiority over Scotland, acknowledged Bruce as the king of Scots, and promised to employ his good offices at the papal court for obtaining a revocation of the spiritual censures, and Robert agreed to pay 30,000 merks to the king of England.

Death of Robert Bruce.
A.D. 1329.

He had at length emancipated his country, and secured its independence, when he died in the fifty-fifth year of his age, and was buried at Dunfermline. He left one son, David the Second, and two daughters.

A.D. 1329.
David the Second, King of Scotland.

David the Second was five years old when he succeeded to the throne; and Randolph assumed the authority of regent.

A.D. 1331.

Edward of England had taken Edward Baliol, the son of the exiled king, under his protection; and, supported by the Lords Wake and Beaumont, with others who had been disinherited by Robert Bruce, he resolved to invade Scotland and vindicate their rights. In consequence of these preparations, Randolph assembled an army, and advanced to the frontier of East Lothian;

A.D 1332.

but learning that the enemy had prepared to invade Scotland by sea, he returned northwards to provide for the defence of the interior of the kingdom, where he died. Donald, earl of Mar, was elected his successor, destitute of political abilities, and inexperienced in war. A naval armament under Baliol appeared in the Frith of Forth, and disembarked in the neighbourhood of Kinghorn. They routed the earl of Fife, and advanced to Dunfermline, whence they proceeded to Forteviot, on the south banks of the Erne.

The regent Mar encamped on the opposite bank, while another army, commanded by the earl of March, had advanced through the districts of Lothian and Stirling to Auchterarder. Baliol took the resolution of crossing the river in the night, and attacking them by surprise, the Scots were routed and slaughtered, and the next day Perth was delivered up to Baliol. He was afterwards crowned at Scone, met Edward at Roxburgh, and acknowledged himself his liegeman, as his father had done. Edward, in return, engaged to support the rights and titles of Baliol to the Scottish crown. Many of the nobles submitted to the conqueror.

The Earl of March, and Archibald Douglas, with Simon Fraser, assembled a body of horse, and surprised him at Annan. His followers were overpowered, and he himself escaped, and took refuge in England.

A.D. 1333.

As he had ceded Berwick to the English, Edward resolved to besiege it without delay. He was assisted by Baliol, who vigorously prosecuted the siege. The Scots made an obstinate defence, and burned a great part of the English fleet. The regent immediately proposed to give battle to the enemy. Edward opposed them in person, and repulsed them with great slaughter, and so complete was the discomfiture, that few of the Scots escaped. On the side of the English scarcely twenty were killed; and the town and castle of Berwick immediately surrendered. It was now believed that the Scottish war was ended. The castles of Dumbarton, Lochleven, Urquhart, and Kildrummy, were commanded by the faithful friends of David. That prince and his consort were conveyed to France, until a more favourable season should arrive to assert his claims.

Surrender of Scotland by Baliol on homage.
A.D. 1334.

Baliol, with the concurrence of the Scottish parliament, surrendered, by a solemn instrument, a great part of the Scottish dominions, to be annexed for ever to the crown of England, did homage, and swore fealty for the kingdom of Scotland and the isles adjacent.

Many of the nobles, disgusted by Baliol's submissions, retired to their castles, or abjured their allegiance. Baliol concluded a treaty with the Lord of the Isles, who consented to be his liegeman, and who received in return the islands of Mull, Sky, and Isla, with the lands of Kintyre and Knapdale.

Sir Andrew Moray, having been liberated from England, was acknowledged as regent, and was indefatigable in harassing the partisans of Baliol. Edward, resolved to overrun the country, led an army into the north, wasted Moray, and penetrated to Inverness; but he had scarcely departed, when the regent traversed the kingdom, surprising and discomfiting his enemies. Edward, busied in preparing for war with France, relaxed his military operations against the Scots; and Sir Andrew Moray having died, was succeeded in that office by Robert, the Steward of Scotland. The new regent dispatched the knight of Liddesdale into France, to implore the aid of the French king, and to acquaint king David with the state of affairs. Meantime the regent prepared to besiege Perth, which had been the head quarters of the English for many years. Liddesdale, who had returned from France with some ships, contributed to the reduction of the town, which was surrendered by capitulation. Stirling castle, after a feeble resistance, was likewise surrendered to the regent. Having thus expelled the enemy from every post to the north of the Frith of Forth, he made a progress through Scotland, to administer justice, redress grievances, and establish good order.

Edinburgh castle was taken by surprise, as was Roxburgh castle. King David returned to Scotland, and during these transactions the English monarch was prosecuting an unsuccessful war in France. A treaty of peace was concluded between England and France, in which the Scots were included by their French ally. But the Scots renewed their incursions into England. Edward complained that the French monarch had secretly encouraged the faithless Scots, and ordered hostilities to be recommeneed.

To embarrass the operations of Edward, David resolved to invade England at the solicitation of the French monarch. He entered England with a body of two thousand men, and a multitude of light armed infantry, and penetrated into Durham, wasting the country, and plundering the ecclesiastics. The English issued a proclamation of array to the northern parts of England.

Nevils' Cross, near Durham, was the scene of conflict. Having routed the right wing of the Scots, the English attacked the centre, commanded by the king in person, and he was made prisener with upwards of fifty barons. The left wing, commanded by the Steward and the Earl of March, retired; though not without loss. The captive monarch was conducted to London, and confined in the Tower; and the English entered Scotland, took Roxburgh castle, and, being joined by Baliol with a body of Gallowaymen, wasted the southern counties.

A truce was concluded between England and France, in which the Scots were included; and, in the ensuing year, negotiations were opened for the release of the captive monarch.

This treaty was at last concluded at Newcastle. His ransom was fixed at ninety thousand merks sterling, to be paid at the rate of ten thousand annually. The king, the clergy, the nobles, the merchants, and burgesses, became bound for payment of the ransom, and observance of the truce. But various causes concurred to frustrate the execution of the treaty for David's release. The French monarch, dreading a new invasion by the English, dispatched an emissary to Scotland with a chosen body of troops, and a considerable sum of money, to be distributed among the Scottish nobility, on condition of their renewing the war. The nobles accepted the French offers, and resolved to invade England.

The Scottish borderers took the field, entered England, and pillaged Norham. Stewart, Earl of Angus, having collected a small fleet, approached Berwick in the night, and scaled the walls; while the Earl of March, with the French troops, seconded the attack. The town surrendered, the inhabitants retiring to the castle, which the Scots were unable to reduce till the town was invested by an army under Edward, when they capitulated and retired.

Despairing of regaining his authority in Scotland, Baliol made an absolute surrender of his kingdom and crown to Edward of England. But this did not increase the authority of Edward in Scotland, and, resolving to extort the reluctant obedience of the barons, he led his forces into Lothian. But the army was involved in difficulties, and had no alternative but to retreat, or to be wasted by famine and the sword. Edward desolated the country, and laid in ashes every town, village, and hamlet that he passed in his retreat.

After this retreat, the Scots expelled his partisans from the west marches. Nithsdale, Annandale, and Galloway, successively surrendered their fortresses, and yielded obedience to the regent; while the English, intent upon the subjugation of France, re-opened a negotiation for the release of the king of Scots. A treaty was concluded at Berwick, in consequence of which David was released after a captivity of eleven years. The ransom agreed upon was one hundred thousand merks sterling, to be paid by yearly instalments of ten thousand. But he visited England a few months after his release; and during the remainder of his reign made many visits to London.

The Scots negotiated alternately with the French and the English; with the former, to obtain a subsidy to enable them the more easily to discharge the king's ransom, though at the expence of a war with England; with the latter, to procure if possible an abatement of the ransom, or to procrastinate the payment.

The king, in a parliament held at Scone, proposed that, in the event of his dying without issue, one of the sons of the king of England should be chosen to succeed him. They unanimously rejected the proposal. The nobles entered into associations for maintaining the legal succession; and took up arms against the person suspected of favouring the king's political views. David had recourse to arms; but a general amnesty was granted.

David the Second died in the castle of Edinburgh, in the 42d year of his reign, and the 47th of his age.

The crown now passed to Robert, the High Steward of Scotland. He was experienced in the art of government, as well as in the duties of a subject.

William, earl of Douglas, at first opposed the accession of the steward, and claimed the crown for himself, as uniting in his own person the pretensions of Comyn and the title of Baliol; but this claim he was compelled to withdraw by the unanimous opposition of the barons. *Robert the Second* was crowned at Scone, and an act was passed, declaring John, earl of Carrick, the king's eldest son, the heir-apparent to the throne; while, in order to secure the friendship of France, the treaty with that country was renewed, the French monarch engaging to support the Scots against the influence and arms of England. It was also enacted, that, failing the heir-apparent and his issue, the following noblemen and their heirs should succeed to the throne: first, The earl of Fife and Monteith; second, Alexander, lord of Badenoch; third, The Earl of Stratherne; and fourth, Walter, earl of Atholl. A.D. 1372.

The national tranquillity was interrupted by the accession of Richard the Second to the English throne. An affray at Roxburgh was the ostensible cause for commencing hostilities, followed by a naval engagement between a small fleet of Scottish, French, and Spanish vessels, and some English merchantmen, which were captured off Scarborough.

A.D. 1378. While the English and Scottish governments were prosecuting measures for pacification, Alexander Ramsay assaulted and took the castle of Berwick by surprise. The earl of Northumberland soon invested the town; and, except Ramsay, none of the garrison escaped from slaughter. The English army marched into the south of Scotland and ravaged the country. A detachment of six-hundred lancemen and archers fell into an ambuscade of the Scots commanded by Archibald Douglas.

A.D. 1380. In two years after, another inroad into England was made by the Scots under Douglas, who surrounded the town of Penrith by night, and burned it; but they carried home with them the plague, which then desolated England, and expiated the miseries they had inflicted. The duke of Lancaster advanced to the frontiers of Scotland with a numerous army, with secret instructions to conclude a peace on the best terms he could obtain. A truce was concluded for two years. Notwithstanding that tranquillity was thus apparently established, the Scots sent an embassy to France, and obtained promises of support and subsidy, as a compensation for being ready to make war upon England when the affairs of their allies rendered it necessary.

The truce with England was permitted to expire, and a short truce was entered into between the English and the French, in which the Scots were not included. The duke of Lancaster, conceiving this a sufficient reason for commencing hostilities, entered Scotland and advanced to Edinburgh; which he spared in gratitude for the hospitality he had there experienced.

A.D. 1384. The Scottish nobles now took up arms, and plundered the northern counties of England with impunity. Conformably to the late treaty, the French monarch dispatched de Vienne, admiral of France, with the stipulated supply into Scotland, with the view of carrying the war into England, and delivering France from invasion. He arrived at Leith, but was greatly shocked at the poverty of the Scots. The equipments for war were scantily supplied; even the necessaries of life could hardly be procured. The French wished to
A.D. 1385.
return home; and, in order to afford them employment, a numerous force was prepared to invade England. Thirty thousand men took the field under the command of the earls of Fife and Douglas; and their French allies entered the English territories, and ravaged the country as far as Newcastle; but learning that Lancaster was approaching, retired with their prey into Scotland. Richard the Second advanced with a large army against the Scots. Dryburgh, Newbottle, and Edinburgh, were successively given to the flames. Stirling, Perth, and Dundee, were destroyed; and the English vanguard advanced to Aber-

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deen. In return, the Scots entered England by the Western Marches, ravaged Cumberland, and besieged Carlisle; and the English, beginning to feel the pressure of scarcity, were reduced to retrace their steps, and were allowed to retire unmolested.

A.D. 1388. An assembly of the Scottish nobles met at Aberdeen, and agreed on an expedition into England, under the command of the king's second son Robert, earl of Fife, and the earl of Douglas. The Northumbrian chiefs prepared to make reprisals, and a spy succeeded in gaining admission into the chapel where the Scottish nobles were deliberating upon their intended operations; but in retiring, was suspected and apprehended. Douglas on this penetrated into Durham, and pillaged the country to the gates of York. The earl of Northumberland despatched his two sons, Henry, surnamed Hotspur, and Ralph, in quest of the Scots. They had retreated northward as far as Otterburn, when they were overtaken by Percy, attended by six hundred lancers and eight thousand infantry, armed with long-bows; and after an obstinate contest, the English were routed. The defeat was complete: the elder Percy was taken prisoner, and the English were almost all slain or taken. Douglas lived but to hear of his countrymen's success.

Battle of Otterburn.

The convention of estates appointed the earl of Fife, the king's second son, to the office of Regent. By consenting to this act, Robert virtually abdicated his throne. A truce for a short time was negotiated between England and France, in which Scotland was included.

A.D. 1390. Death of Robert the Second, and accession of Robert the Third.

Robert died at his castle of Dundonald, in the seventy-fifth year of his age, and the nineteenth of his reign.

Robert the Third.—John, the eldest son of the late monarch, assumed the government, but his name being deemed inauspicious, it was changed to Robert. After his coronation at Scone, he intrusted the government to his brother, the earl of Fife; who, for the first eight years of his reign, succeeded in maintaining peace with England and France. But to maintain domestic tranquillity was a more arduous task. Duncan Stewart, the king's nephew, made a descent upon Strathmore, and plundered the country. They were attacked by the sheriff of Angus, assisted by Sir David Lindsay, who were defeated, with the loss of sixty men.

A.D. 1390.

A.D. 1392.

A.D. 1398. Richard of England was dethroned by the earl of Lancaster, who successfully usurped the English throne. The Scottish borderers availed themselves of the opportunity offered by these domestic troubles, to make an inroad into England; set fire to the castle of Wark, and wasted the adjacent country. A repetition of similar insults compelled the English monarch to deliberate on retaliation; and Henry the Fourth resolved to send an army into Scotland, being the last invasion conducted by an English monarch in person. The earl of March, enraged by an insult received from the Scottish government, swore fealty to Henry; and upon his arriving at the borders, Henry despatched an order to the Scottish king, the prelates, and the nobles, to meet him at Edinburgh, and pay him homage as lord paramount. In answer to this mandate, the Scots composed a ballad; and the invaders advanced to Edinburgh, and assailed the castle without success. Albany collected a numerous force, with which he boasted he should drive the invader from the kingdom; but this was followed by no active operations.

A.D. 1400.

The moderation and clemency of Henry during this invasion, merit eulogium. The towns that submitted were saved from plunder; and no instance of wanton cruelty was committed. A threatened insurrection in England induced the invaders to retire.

An unhappy difference occurred between the dukes of Albany and Rothsay. Albany, by his intrigues, had alienated the affections of the king from his son; the queen, however, had the prudence to interpose; and, to counteract the ambition of Albany, she proposed that the prince should marry. Alarmed at this measure, the regent involved the king and the prince in a quarrel with the earl of March. His castle at Dunbar was reduced by Douglas. Being joined by Percy, he made an irruption into Scotland, but was chased by Douglas into England.

A variety of petty incursions were made into England with various success. Engaged in crushing a rebellion in Wales, Henry left the protection of the northern counties to the wardens. Of these irruptions, that which led to the battle of Homeldon was the most remarkable. The earl of Douglas, assisted by Murdoc, Albany's son, entered England with an army of ten thousand men, and carried devastation to the walls of Newcastle. The earl of Northumberland, his son Hotspur, and the earl of March, collected their vassals, and overtook the Scots at Homeldon hill. The English bow decided the fate of the day. Douglas was taken prisoner, after being severely wounded. Murdoc was also made prisoner, but liberated soon after.

The remainder of this reign is marked by few important events. During the rebellion in England, raised by Hotspur, the regent Albany collected a numerous army, with the intention of making an irruption into Northumberland. Upon the news of Hotspur's defeat and death, he abandoned the design and dismissed his troops.

It is probable that a disclosure of Albany's conduct induced the secluded monarch to provide for the safety of his only son, James earl of Carrick. By the advice of Wardlaw, bishop of St. Andrews, the prince was put on board a vessel to be conveyed to France. He had proceeded on his voyage as far as Flamborough Head, when he was captured by an English ship, and conveyed to London. He was then only eleven years of age. His father sunk under his misfortunes in the seventeenth year of his reign.

After the king's death, a parliament assembled at Perth; the title of the captive prince to the sovereignty was recognised, and Albany's authority as regent was confirmed. The first acts of his government were a renewal of the treaty with France, and an insincere negotiation for the release of the prince.

About this time the flames were first kindled in Scotland for burning heretics. James Resby, an English priest of the school of Wickliffe, was condemned at Perth by a clerical council, who delivered him over to the secular power. Edward was now more intent upon extending his influence on the continent, than subjugating the Scots. Donald, lord of the Isles, received a signal defeat at Harlaw; being compelled to make submissions and deliver hostages for his future observance of peace.

A papal bull which had been drawn up against England by Urban the Fifth, was now promulgated; threatening with infamy and spiritual punishment, all persons who durst invade Scotland.

A series of border hostilities marked the weakness of the government, and the turbulent character of the people. Negotiations were again opened for the release of prince James, without effect; and Albany, having governed the kingdom for thirteen years, or, including his direction in the councils of his father and brother, thirty-four years, died at the age of eighty. He was succeeded in the regency by his son Murdoc; and during his government of four years, Scotland was nearly in a state of pure anarchy.

The death of Henry in France, and the appointment of the duke of Bedford as protector of England, presented at length an expectation to the Scots that their captive prince would be set at liberty. With the concurrence of the councils of both kingdoms, a treaty was agreed upon. Forty thousand pounds in lieu of maintenance and education, were promised by the Scots in annual instalments of two thousand; and the boroughs of Edinburgh, Perth, Dundee, and Aberdeen, granted a security for the payment of the prince's ransom.

James espoused the duke of Somerset's daughter, and received as her portion a remission of ten thousand pounds of his ransom. After a captivity of nineteen years, he arrived in Scotland, and was received with universal acclamations.

James the First.—James had attained his thirtieth year when he returned to govern his native kingdom. In order to reform the police of his kingdom, it was necessary to maintain peace with England. A truce for seven years was concluded, which afforded leisure and opportunity for promoting that object. Murdoc and two of his sons were apprehended, condemned, and executed. James, the regent's youngest son, escaped to Argyllshire, was pronounced an outlaw, and fled to Ireland; whence he never returned.

The frequent assembling of parliaments during this reign, evinces the king's confidence in his people, and their reverence for his authority. Many salutary laws were enacted, which he enforced with a resolute authority. The acts of this parliament form the first of a regular series of Scottish laws, and display a considerable degree of political prudence. The Highland chiefs
5. had rendered themselves obnoxious to the government, and an example of severity was necessary. For this
7. purpose a parliament assembled at Inverness, which the Highland chiefs were summoned to attend. Many of them were instantly seized and cast into prison; and a few of them were executed. The lord of the Isles and his brother suffered a temporary confinement.

8. Notwithstanding the amicable relation maintained with England, it was deemed expedient to renew the ancient league with France. The depressed condition of the latter kingdom, suggested the propriety of a marriage alliance between the dauphin and the princess royal of Scotland. In lieu of dowry, six thousand men were required and promised, to aid the French against the English. A scene of rebellion was again exhibited in the Highlands. The lord of the Isles, who had regained his liberty, raised the standard of rebellion, and burned Inverness; but was subdued, and confined in Tantallon castle. Donald Balloch, a relation of the chief, ravaged Lochaber, and defeated the Earls of Mar and Caithness; but fled to Ireland.

3. The marriage of the dauphin to the princess of Scotland was an unhappy connexion for the bride. She was conducted to her betrothed husband at the age of twelve, lived nine years in splendid misery, and fell a sacrifice to unfounded jealousy.

An infraction of the truce with Scotland by some of the English borderers provoked James to retaliate. Having summoned the whole force of his kingdom to meet him in arms, he invested Roxburgh castle, which he failed to reduce. It was impossible to procure provisions, and a retreat was therefore the only alternative. James had incensed the nobles by his vigorous administration. The commonalty were also displeased, because of the taxes imposed, which they were disposed to view in the light of extortion.

Sir Robert Graham, uncle of the Earl of Stratherne, had suffered imprisonment from some unknown cause. Being of a resentful disposition, he persuaded a number of the nobles and gentry to support him in representing their grievances to the king. But his violence led him to excess. He rose from his seat in parliament, advanced to the throne, and laid his hand upon the king. He was immediately ordered into confinement; and was sentenced to suffer banishment, and confiscation of his property. He then sent a defiance in writing to the king, renouncing his allegiance, and denouncing vengeance. A royal proclamation was issued, offering a large reward for his apprehension, while he was organizing a conspiracy against the king's life. Walter, Earl of Atholl, the king's uncle, and Sir Robert Stewart his nephew, were the principal accomplices. Graham offered to support Sir Robert's pretensions to the crown, in the event of the king's assassination.

The murder was committed at Perth, where the court had been celebrating the festival of Christmas. James died in the 44th year of his age, and the 13th of his reign. But in a few weeks the leaders of the conspiracy were seized, tried, and executed. James left one son and five daughters.

Murder of James I. and accession of James the Second. A.D. 1437.

James the Second, a child of six years of age, succeeded his father, and was crowned at Scone. A very judicious parliamentary enactment was promulgated, revoking all alienations of lands or other property belonging to the crown since the death of the late king, except what had been sanctioned by the estates; and interdicting all future alienations, unless sanctioned by the parliament.

The state of the kingdom required that the hostilities commenced before the late king's death should be discontinued. A truce for nine years was concluded with England. An unhappy rivalship between Crichton and Livingstone weakened the authority of the government. The nobles relapsed into their former feuds.

The house of Douglas had been aggrandised by an accession of possessions and titles of honour. The chancellor, apprehensive of danger from Douglas's exorbitant power, adopted an impolitic expedient to destroy him. He invited the earl and his brother into the castle of Edinburgh, where, after the semblance of a trial, they were beheaded. James, lord of Abercorn, succeeded to the estates and titles of Douglas, and transmitted them to his son, who married Margaret, the Fair Maid of Galloway, and the sister of the late murdered Earl of Douglas. Thus the house of Douglas was raised to its former influence and splendour. The king's ministers were the first to feel the resentment of a nobleman, whose power became formidable even to the throne.

A.D. 1440.

Having attained his fourteenth year, James was persuaded to assume the government in person. Douglas insinuated himself into his favour and confidence, and procured the dismissal of the late administration. Crichton and Livingstone were soon after denounced as rebels, and their estates confiscated. In revenge, the chancellor, who had shut himself up in the castle

A.D. 1415.

of Edinburgh, wasted the estates of Douglas. A royal army, under the king, invested Edinburgh castle, and Douglas was created lieutenant-general of the kingdom.

The earl of Huntingdon and Lord Percy entered Scotland with 15,000 men. They were met and defeated by a force under Douglas. The earl of Salisbury, lord-lieutenant of the north of England, raised an army to revenge his countrymen; but the Scots attacked him, routed his army, and ravaged the north of England.

An embassy under Crichton proceeded to France, to renew the ancient league, and to select a bride for James, now in his sixteenth year. They accordingly entered upon a matrimonial engagement with Mary, daughter of the duke of Guelderland. The bride landed at Leith, and the nuptials were celebrated with much pomp.

A.D 1450.

A truce was concluded with England, which might be violated by either party, upon giving a notice of 180 days. James assembled a parliament at Edinburgh, and enacted a variety of statutes which evince his wisdom and beneficence. Douglas withdrew from court, and passed to Rome to witness the celebration of the jubilee. Upon his return home, he persevered in his treasonable conduct, attempted to assassinate the Chancellor, and formed a league with the Lord of the Isles.

Assassination of Douglas by James.
A.D. 1452.

Several incidents of a less important character served to exhibit the cruelty of Douglas, and exasperate the king, who, with the advice of his council, determined upon private revenge. The earl was invited to visit the court at Stirling. After supper, the king, taking him into a private chamber, mildly desired him to dissolve his illegal combinations. But the earl proudly refused, and upbraided the king as the cause of the confederacy. James, with fury, exclaimed, "If you will not break this league, I shall!" and instantly stabbed him with his dagger. An attendant struck the earl with a battle axe, and he fell mortally wounded. Crawford, one of Douglas's confederates, on hearing of his fate, rose in arms. He was met near Brechin by Huntly, and defeated with great slaughter. The four brothers of Douglas threatened the king with vengeance, but James's forbearance and authority induced them to return to their duty.

In the subsequent part of this reign, the most prominent transaction is the final ruin of the house of Douglas. Earl James had entered into a treasonable engagement with Richard duke of York, who directed the councils of England. The king of Scots was the friend of Henry, and therefore displeased with the usurpation of York, who necessarily availed himself of the alliance with Douglas to retaliate upon James, and prevent his interference in the affairs of England.

A.D. 1454.

Upon discovering the designs of Douglas, James summoned him to appear at court. The earl not only disobeyed, but caused placards to be stuck charging the king with the murder of the two late chiefs of the house of Douglas. An army was immediately sent to ravage the lands of the contumacious earl, and to besiege his castle of Abercorn. Douglas retired to the border, and applied for aid to the English ally, who sent him a pecuniary remittance, on which he resolved to raise all his vassals and adherents to give battle to the king, or expel him from the kingdom. In this extremity, the king passed over to St. Andrews, issued a proclamation summoning the array of the north, and offering an amnesty to all who should join his army.

A considerable force speedily assembled, and the king marched to Stirling, where, being joined by the troops from the northern shires, his army amounted to 40,000. The royal army then advanced to give the rebels battle, and in one night the whole forces of the Earl deserted him, on which he fled to Annandale, and afterwards to England. On this, the castles of Abercorn, Douglas, Strathaven, and Crieff in Galloway were razed, and the family estates confiscated.

A truce for nine years was concluded with England; but the civil dissensions in that kingdom rendered the continuance of peace very precarious. From some uncertain cause, James advanced with an army to Roxburgh castle, which had remained in the hands of the English since the battle of Durham. In this siege, while the king was observing the effects of his rude cannon, one of them burst, and he died almost instantaneously, in the twenty-ninth year of his age, and the twenty-fourth of his reign. He left three sons and two daughters.

James the Third, at eight years of age succeeded his father, and was crowned at Scone.

Henry the Sixth of England having been defeated by Edward the Fourth, fled to Scotland, and engaged the sympathy of the queen regent. Berwick was conceded to the Scots, who, in return, sent an army into England, but they were compelled to make a disastrous retreat. George, earl of Angus, was engaged to assist the unfortunate Henry by the promise of a ducal dignity, with an estate in England. To balance the influence of Henry in Scotland, his successful rival, Edward the Fourth, entered into a negotiation with the Lord of the Isles, who became the liege subject of Edward for a pension, and by the promise of ample territories when his country should be subdued. James had entered his fourteenth year when his venerable preceptor Kennedy died.

Lord Boyd was appointed guardian of the king and his family, and was created constable of Scotland.

An embassy was sent to Denmark, to adjust a protracted dispute relative to the arrears due for the western islands. At the suggestion of the king of France, a marriage was concluded between the king of Scots and the princess of Denmark. In lieu of dowry, her father consented to cancel the arrears, and to make a permanent cession to the crown of Scotland of the Orkney and Shetland islands. Margaret of Denmark arrived at Leith, and was married and crowned, though only in her thirteenth year. James's character, upon his assuming the chief authority, began to be delineated, in his attachment to favourites, his love of retirement and the arts, and his consequent inattention and aversion to public business. The parliament was put upon the dependent footing of a mere court of justice, existing by the royal pleasure, and assimilated in terms of contempt with the inferior courts.

In the fall of the houses of Douglas and Boyd, the aristocracy received a severe blow. James aimed to rule with absolute authority; but his genius was inadequate to the attempt, and he fell a sacrifice to the resentment of the incensed nobility. A very important treaty was entered into by the English and Scottish monarchs. The king of England offered his daughter Cecilia, only four years of age, in marriage to the prince of Scotland, a child of two years; and with her a portion of twenty thousand merks, to be paid in ten years by annual instalments.

Having thus secured the friendship of England, James enjoyed full leisure to improve the domestic policy of his own kingdom, by reducing more completely the Western Islands. The Lord of the Isles was summoned to appear at court; but disobeying the royal mandate, sentence of forfeiture was pronounced against him, which induced the refractory chief to appear in parliament and supplicate the royal clemency. In consequence of his engaging to maintain the laws of the kingdom, he was confirmed in his jurisdiction and title as Lord of the Isles, but was deprived of the earldom of Ross, and of Knapdale and Kintyre.

Events of an inauspicious aspect concurred to hasten the tragical termination of James's reign. His brothers, Albany and Mar, were princes of a character dissimilar to the king's. They associated with the nobility, and excelled in martial exercises; while he, neglecting the duties of his high station, incurred the contempt of the haughty nobility. The wardenship of the eastern marches had been assigned to Albany by his father; the command of Berwick and the lieutenancy of the borders had been subsequently intrusted to him by his brother. A violent feud existed between Albany and the Homes and Lindsays; and in order to procure Albany's ruin, his enemies applied to Cochrane, one of the king's favourites, who reported, on the prediction of a witch, that he should be slain by one of his nearest kindred. The monarch's suspicions immediately fell upon his brothers, and they were seized and confined in separate fortresses. Albany effected his escape to France, but Mar was brought to Edinburgh and bled to death.

An infraction of the truce with England occasioned alternate incursions of the English and Scots, unimportant in the details. Instigated by revenge, Albany was persuaded to pass over from France to England, and to enter into a treaty with Edward the Fourth to dethrone the king of Scots. James applied to his parliament, but the nobles took the field with a stronger disposition to regain their lost authority, than to annoy the enemy. About 50,000 men attended the king from Edinburgh to Lauder, where the nobles deliberated upon their purpose of revenge. The obnoxious royal favourites were Cochrane, Hommil, Leonard, Rogers, and Forfyan. Cochrane had been created earl of Mar. It was determined that James should be placed under restraint, and that his favourites should be hanged over the bridge at Lauder. This resolution was speedily executed, and the king was conducted to Edinburgh castle, and there confined. Meanwhile, the English took Berwick, and advanced to Edinburgh; but Albany, finding the nobles indisposed to dethrone the king, sued for a pardon, and obtained it. The English army retired. Albany's ambition revived by his security; he renewed his treasonable correspondence with the court of England, which being discovered, he became a second time an exile in England.

Richard the Third was disinclined to second the views of Albany; but Douglas agreed to assist him in his designs upon the kingdom, and entered Scotland with five hundred horse. But the name of Douglas had lost its influence, and Albany was despised. Their troops were soon overpowered; Albany escaped to France, where he died; and Douglas was sentenced to be imprisoned for life in Lindores abbey.

A train of misfortunes preceded the conclusion of James's unhappy reign. Untaught by the tragical fate of his former favourites, he relapsed into his former conduct, associating with persons of mean birth, and secluding himself from the nobility. A conspiracy was formed to imprison and dethrone the king; but he had influence to muster an army of 30,000 men. The disaffected nobles prepared a formidable force. Both parties were, however, reluctant to put the issue of the contest upon a battle, and James disbanded his troops. His pusillanimity emboldened his enemies to re-assemble their adherents, and they constrained the prince to become their nominal leader. The king proceeded to Stirling castle, to join the loyal peers who were advancing to his help, and was advised to hazard an engagement near Bannockburn; but the action had scarcely commenced when he fled. He was thrown from his horse, and a priest being called to hear his confession, one of the rebels being conducted to the unfortunate monarch under this pretence, stabbed him to the heart.

Death of James III. and accession of James IV. A.D. 1488.

James the *Third* was killed in the thirty-sixth year of his age and the twenty-eighth of his reign, leaving three sons.

James the *Fourth* succeeded his father, and was crowned at Scone. A revocation of all lands, dignities, and offices, granted since the commencement of the civil war, was published. The estates passed an act of indemnity; but the part which the young king had taken in the late contest, excited his remorse; and, as an evidence of his contrition, he constantly wore an iron girdle.

A.D. 1493.

The independence of the Scottish church having been threatened by the encroachments of the Roman court, the estates enacted several ordinances. The foreign disposal of elective benefices was annulled; the ecclesiastics threatened with punishment, if they violated at Rome any statute of the realm or privilege of the Scottish church; all appeals to Rome in civil cases were prohibited; benefices were guarded from papal exactions; and no person was to be allowed to appear as legate in Scotland, except he were a native, or had attained the rank of cardinal. A statute was passed for encouraging the fishery.

A.D. 1496.

The example of the monarch, who delighted in martial exercises, music, and the arts, accelerated the progress of civilization and refinement, but his romantic spirit plunged his country into a war with England. James believed, or affected to credit the account of Warbeck's legitimacy, and gave him in marriage the lady Catharine Douglas, daughter of the earl of Huntly. Determined to make a vigorous effort in favour of Perkin, he raised a considerable army, and entered England, but soon abandoned the enterprise as hopeless, and dismissed Perkin as an impostor.

Henry the *Seventh*, sensible that the impostor would soon be exposed, commanded his lieutenant of the north of England to retaliate with moderation; and offered his daughter in marriage to James, who was prevailed upon to consent to an alliance when she should attain her fourteenth year.

A.D. 1503.

Conformably to the marriage treaty, the princess Margaret arrived in Scotland, and was wedded to James. In their alliance was laid the foundation of the union of the two kingdoms, and from this union sprang a negotiation, which terminated in a treaty of peace, that was broken in the course of ten years. The tranquillity of the kingdom presented a favourable opportunity for improving the domestic policy, especially of the Highland districts. A sentence of forfeiture was issued against John lord of the isles, and his territories were annexed to the crown. It was ordained that the highlands and islands should be governed by the common laws of the land, and not by feudal autho-

Having received from France a reinforcement, the queen regent detached a party to lay waste the adjacent country. In this pressing extremity, the lords of the congregation turned their eyes towards England, and Maitland and Melville were dispatched to solicit succours from the queen of England. Elizabeth's ministers did not hesitate to grant a request so consonant to the wishes and interests of their mistress, and they instantly dispatched a squadron to cruise in the Frith of Forth. After the flight of the congregation to Stirling, the queen dowager took possession of Edinburgh; but her scheme was rendered abortive by the alliance of her enemies with the English queen. Early in the spring, Elizabeth sent 6000 foot and 2000 horse into Scotland, under Lord Grey of Wilton. To meet their allies, the forces of the Reformers assembled from all parts of the kingdom, and the combined army, amounting to 13,000 men, besieged Leith. The French garrison was speedily reduced to great difficulties, and the queen dowager retired to the castle of Edinburgh, where she died soon after.

The French court now abandoned their schemes of distant conquest. It became necessary to withdraw the few veteran troops in Scotland, instead of sending new reinforcements to that country. A negotiation was therefore opened, through the mediation of Elizabeth. Two separate treaties were concluded at Edinburgh, and it was stipulated that the French troops should immediately evacuate Scotland; that Francis and Mary should thenceforth abstain from bearing the arms of England; that an amnesty should be published for all past offences; that none but native Scotsmen should be eligible to fill any office of state, or hold either civil or military authority; that the parliament should nominate twenty-four persons, of whom the queen might select seven, and the estates five, for conducting the government during their sovereign's absence; and that Mary should make neither peace nor war without the consent of parliament.

Being masters of the kingdom, the leaders of the congregation speedily completed the work of reformation. A parliament was convened, to settle the internal tranquillity of the country, and the protestant members greatly outnumbered their adversaries. After ratifying the late treaties, the Parliament approved of a Confession of Faith which had been composed by John Knox and other protestant leaders. Several acts were passed against the catholics; and the presbyterian form of church government was established nearly as it exists at present. Thus the Reformers, who had just escaped ecclesiastical tyranny, proceeded to imitate those examples of severity.

Sir James Sandilands was sent to France, to obtain the Queen's ratification of these acts. But Mary refused to ratify them. The reformers, nevertheless, immediately put them in execution. They abolished the mass, settled their ministers, and committed devastations on the catholic edifices. Abbeys, churches, and even mausoleums, perished in one common ruin. The protestant nobility also dispatched ambassadors to Elizabeth, to solicit a continuance of her support. Francis and Mary continued to assume the title and arms of England, and refused to ratify the treaty of Edinburgh. By the death of Francis the Second, Elizabeth was delivered from the perils attending the union of Scotland with France, and the Scottish protestants were freed from the terror of the French power. Mary retired to Rheims, but still declined to ratify the treaty of Edinburgh, and to make a solemn renunciation of her pretensions to the English crown.

On learning the reverses of their queen, the Scots sent a deputation to France, inviting her to return to her native country, and assume the reins of government.

No sooner did the French galleys appear off Leith, than the people of all ranks hastened towards the shore, to behold and welcome their young sovereign. She had attained her nineteenth year, was skilled in various languages, and had studied music, poetry, and rhetoric. Accustomed from her infancy to magnificence and splendour, she was deeply affected with the change, and was conducted to Holyrood house. During these transactions, the protestant preachers had received a considerable accession of numbers, from a concatenation of events which had contributed to the rise and progress of the reformed doctrines.

The first measure of Mary's government confirmed the affections and confidence of her subjects. She bestowed her favours entirely through the protestant leaders, invested her brother lord James with the authority of her lieutenant, and appointed Maitland as his deputy. But on the Sabbath-day after her arrival, the queen commanded that mass should be celebrated in the chapel of her palace, when her catholic servants were insulted, and her conversion from popery was publicly prayed for; while Lindsay and the protestant gentlemen of Fife exclaimed, "the idolater shall die the death!" But the prior of St. Andrews, and the other leaders of the protestants, restrained their zeal, and obtained for the queen and her domestics the indulgence of the free exercise of their religion. Mary consequently issued two proclamations, declaring, that "any attempt to alter or subvert the protestant religion without the sanction of the legislature, should be considered a capital crime."

She was now surrounded by a turbulent nobility, and her religion was a popular theme of declamation from the pulpits. She therefore despatched Maitland to London, to signify her willingness to renounce all present right to the English crown, provided she should be declared, by act of parliament, next heir to the succession, in case of Elizabeth's decease without issue.

Maitland was likewise instructed to express his mistress's earnest desire to cultivate an amicable correspondence with the queen of England. But Elizabeth would not condescend to name a successor; and sensible that Mary's proposal would seem reasonable, ceased to demand the ratification of the treaty of Edinburgh.

A convention of estates was summoned, chiefly on account of ecclesiastical affairs. The general assembly presented a petition to the states, requiring the suppression of popery, and praying for a legal maintenance to the protestant clergy; but the nobles were now deaf to their entreaties. The whole revenue of the protestant clergy was settled at only twenty-four thousand pounds Scots.

Although the protestants filled the cabinet, they did not possess the queen's confidence. The prior of St. Andrews had been created earl of Murray; the earl of Huntly raised the standard of insurrection with the avowed design of being revenged on Murray, but in reality to rescue the queen from the hands of the protestants. At the same time the archbishop of St. Andrews endeavoured to unite and root papists in the south; but Murray suddenly marched from Aberdeen, and with a few chosen troops, attacked and defeated Huntly.

2. In the same year, Mary dispatched Maitland to London to desire a personal interview with Elizabeth near the borders, but the conference was declined. About two years had elapsed since Mary became a widow. Her subjects were desirous that she should marry, in order that the crown might descend in a direct line from her ancestors.

The murder of the duke of Guise disinclined the queen of Scots to wed a native of France. She chose for her consort Henry Stewart, lord Darnley, eldest son of the earl of Lennox. Darnley was her cousin-german, and was, after herself, next heir to the English throne. On that account, Mary expected the consent of Elizabeth, who had declared that nothing would so effectually promote a permanent union between the sister kingdoms, as Mary's espousing an English nobleman. Yet no sooner was Elizabeth informed that the preliminaries of the marriage were settled, than she exclaimed against it, commanded Darnley to return to England, seized his English estates, and threw his mother and one of his brothers into prison. She thus hoped to alarm her partisans in Scotland, and to raise commotions that might afford her an opportunity to become umpire between Mary and her contending subjects.

The earl of Murray entered into a bond with several protestant lords, and they formed the design, with Elizabeth's concurrence, of carrying Darnley to England, should they fail of frustrating the marriage. But the project failed, and the queen's nuptials were celebrated with general approbation.

The associated lords assembled their vassals, and prepared for defence; but Mary collected troops, and put herself at their head. The malcontents fled to England, where Elizabeth publicly disavowed all connection with them, and banished them from her presence.

The courts of France and Spain had entered into he holy league, to exterminate the protestants in rance and the Low Countries; and to extinguish the formed doctrines. Mary joined this confederacy, ummoned a parliament for attainting the exiled lords, nd for the establishment of the Roman catholic worship n Scotland; but an unexpected incident saved both, nd proved the ruin of Mary herself.

Her marriage with Darnley had been precipitated; nd, having leisure to remark his weaknesses and vices, he resolved to proceed with more reserve. Enraged y her neglect, Darnley pointed his resentment against ery one whom he deemed the cause of this change. he chief object of his vengeance was David Rizzio, a rson of mean birth, who had gained admission into the een's family by his skill in music, and was regarded her chief confidant and minister. He communited his resolution to the Earl of Morton, and imored his assistance; but the conspirators engaged him sign a paper, promising them protection from every ngerous consequence.

A messenger was despatched to the exiled lords, th an invitation from the king to return home. Mor n seized the gates of the palace, while Mary was at pper with the Countess of Argyll, Rizzio, and other vants. The king entered the room by a private or, and the conspirators rushed in after him. Dou s seized Henry's dagger, and stabbed Rizzio, who s dragged to the antichamber and murdered. Apprehensive of her resentment, the assailants confined her a prisoner in the palace. The Earl of Murray, with his exiled associates, appeared two days after. A reconciliation with the queen was obtained. They obtained an acquittal from parliament, and were reinstated in their honours and fortunes.

Rizzio's murderers applied for pardon; but Mary avoided compliance, escaped to Dunbar, collected an army, and marched to Edinburgh. The assassins fled to England; but the Earl of Bothwell interceded in their behalf, and procured their pardon.

Birth of James VI.

James the Sixth was born in the castle of Edinburgh, in June 1566. Melville was despatched to announce the happy tidings to Elizabeth, who professed the greatest regard for the queen his mistress. The birth of a son to Mary gave additional courage to her partisans in England, and the opposite parties began to demand a settlement of the succession. Elizabeth determined to oppose the discussion, and Mary's indiscretion threw her from the summit of prosperity, and finally plunged her into ruin.

James, Earl of Bothwell, had distinguished himself by his attachment to the queen, and his opposition to the Earl of Murray; whence she, in return, gratified him with marks of confidence, and elevated him to offices of power and trust. Surmises were, however, circulated, disadvantageous to her character; and so strong was her aversion to her husband, that he retired to Glasgow. A disorder which seized him soon after was ascribed to a dose of poison; but Henry had no suspicion of personal danger, and accompanied the queen to Edinburgh. He was lodged in a solitary house, called Kirk of Field, not far from the palace of Holyroodhouse. Mary attended him assiduously; but on the 9th of February she suddenly left him, to be present at the marriage of one of her servants. About two o'clock next morning, the city was alarmed by a tremendous explosion. The king's residence was blown up by gunpowder, and his dead body was found in a neighbouring enclosure. The Earl of Bothwell was generally considered as the author of this horrid murder; and suspicions were propagated that the queen herself was privy to the crime.

A.D. 1567.

Death of Darnley.

Her conduct evinced unaccountable apathy. Several days elapsed before any steps were taken to discover the murderers. She delayed to bring Bothwell to a trial, permitted him to enjoy all the dignity and familiarity of a favourite, committed to him the government of Edinburgh castle, and thus gave him the command of the south of Scotland. She was carried off by him, and lived with him, and, as soon as he had procured a sentence of divorce from his wife, the queen publicly married him.

The news of these transactions threw an odium on the nation, and, with Bothwell's attempt to seize the young prince's person, roused the Scottish nobles. A considerable body of them, headed by the Earl of Athol, assembled at Stirling, while, to shelter Bothwell and herself from the impending storm, the queen issued a proclamation, requiring her subjects to assemble round her standard, for the defence of her husband. She likewise circulated a manifesto, vindicating her government, and expressing an anxious concern for the safety and happiness of the prince. But the associated lords had assembled an army before the queen and Bothwell were prepared. Lord Hume suddenly surrounded the castle of Borthwick, where the queen was; but she escaped to Dunbar, and speedily collected such a force as to offer her enemies battle

The two armies met at Carberry; but Mary soon became sensible that her troops were disaffected, and, after some bravadoes of Bothwell, she surrendered herself into the hands of the confederates, who conducted her to Edinburgh amidst the insults of the populace.

Bothwell sailed for the Orkney islands, where he was pursued by Kirkaldy of Grange, and having escaped in a boat, proceeded to Denmark, where he was thrown into prison and died.

The queen experienced the most severe treatment, and was sent under a guard to Lochleven castle, with a warrant to William Douglas to detain her as his prisoner. The mistress of the house was the Earl of Murray's mother, who pretended to have been lawfully married to the queen's father: she therefore hated her captive, and treated her with severity. When the news of these events reached England, Elizabeth despatched an ambassador to negotiate with the queen and her enemies; but the ambassador was denied all access to her, and the confederates eluded every proposal on her behalf, while the protestant preachers inflamed the minds of the people against their sovereign.

Murray's resignation at Lochleven castle.

Under these circumstances, it was deemed eligible to establish a regency; and the greatest number of the associated lords gave their suffrages to elevate the Earl of Murray to that dignity. Lord Lindsay was appointed to acquaint the queen with the general determination. She signed three instruments, resigning the crown to her son, appointing Murray regent, and nominating a council to administer the laws till his arrival in Scotland. In consequence of her resignation, the young prince was proclaimed by the title of James the Sixth, and was crowned at Stirling. The Earl of Murray arrived in Scotland soon after, and was invested with the regency. He summoned a parliament, which ratified the queen's resignation, and confirmed his appointment to the regency. Sir James Balfour was bribed to surrender the castle of Edinburgh, and the garrison of the castle of Dumbarton was compelled to capitulate.

A. D. 1567.

Notwithstanding the apparent unanimity, there were many secret murmurs and cabals. The rigour of the queen's sufferings moved many who blamed her imprudence; and a party of the nobility met at Hamilton, and concerted measures for supporting her interests. Meanwhile the queen was devising means for her escape, and succeeded in regaining her liberty by the aid of her keeper's brother, George Douglas, who conducted her in disguise into a small boat, and accompanied her to Hamilton, where she was speedily attended by a train of nobles, and an army of six thousand. A bond of association was signed for her defence, and it was declared that the queen's resignation was illegal and void.

Elizabeth, informed of Mary's escape, dispatched Maitland with congratulations and promises of support; but the queen's fate was decided before succours could arrive. The regent was at Glasgow when he received information of the queen's escape, and, notwithstanding his inferiority, took the field, and awaited the approach of the enemy. A battle was fought at Langside, which was decisively in favour of the regent, and the queen's army was dispersed. The queen had beheld the engagement from a neighbouring hill, and when she saw her army broken and routed, she fled southwards to the abbey of Dundrennan, a distance of sixty Scots miles from the field of battle.

She there deliberated upon the most eligible steps. If she remained in Scotland, she anticipated a prison or death. She was unprovided with the means of escaping to France; and as the late behaviour of Elizabeth afforded some hope of protection and assistance, she overlooked all other considerations, and resolved to take shelter in England.

Notwithstanding the entreaties and remonstrances of Lord Herries and the archbishop of St. Andrews, she embarked on board a fishing-boat, and landed the same day at Workington, about thirty miles from Carlisle; dispatched a messenger to London, announcing her arrival, and desiring leave to visit Elizabeth, and soliciting her protection. Elizabeth had now in her hands a hated rival, yet policy required some show of friendship and humanity to Mary; but observed, that while the queen of Scots lay under the imputation of a crime so horrid as the murder of her husband, she could not admit her to an audience. She, therefore, required that Mary should clear herself of the crimes alleged against her, when she might depend upon a reception suitable to her dignity, and support proportioned to her necessities.

Mary was overwhelmed with surprise and grief, but she had no choice, and therefore agreed to submit her cause, in the confidence of justifying herself. Elizabeth now began to act as umpire between the queen of Scots and her rebellious subjects, and immediately sent to the earl of Murray, requiring him to desist from the prosecution of the queen's party, and to delegate some persons to justify his conduct against his sovereign. The regent replied, that he would himself take a journey to London, attended by other commissioners, and would willingly submit the determination of his cause to Elizabeth. Mary now perceived the snare laid for her. She, therefore, retracted her offer, and declined making any reply to the accusations of her subjects; though she was ready, out of friendship to Elizabeth, to satisfy her scruples, and Lord Herries, in her name, requested present aid from England, or liberty for his queen to pass over to France.

Elizabeth submitted the affair to the privy council, who agreed that she could not permit her to leave the kingdom, and it was also deemed necessary to remove the royal captive to Bolton castle. Mary had already experienced the miseries of imprisonment, and Elizabeth availed herself of this to extort her consent to the intended trial. Allured by plausible professions, Mary agreed to vindicate herself by commissioners. While the English court was employed in these deliberations, the regent Murray resolved to proceed against his prisoners and the queen's partisans, with the greatest rigour. He marched with 5000 troops into the west of Scotland, with the intention of reducing the Hamiltons, and laying waste their estates; but disbanded his forces in compliance with the wishes of Elizabeth.

He afterwards called a parliament, to obtain a legal sanction for attainting those nobles who refused to acknowledge the king's authority. Argyll and Huntly assembled their forces to prevent the meeting, but Mary commanded them to lay down their arms. A few of the queen's partisans were punished; the rest were allowed still to hope for favour, but before Mary's commissioners gave in their complaints, they entered a protest, stating that their appearance in this cause should not be understood as compromising the dignity of her crown, or as an admission of subordination to England.

During the conference, the queen's commissioners seemed to triumph, as the regent had cautiously declined accusing her of any participation in the guilt of her husband's murder. He therefore demanded of the English commissioners, whether they were invested with authority to pronounce sentence against the queen, in case her guilt should be proved; whether they would deliver an actual sentence without delay; whether she would be delivered into the hands of the regent, or be so effectually restrained as to be unable to disturb the government now established in Scotland; and whether Elizabeth would acknowledge the young king, and protect the regent. Instead of resolving them, Elizabeth removed the conference to Westminster, and appointed new commissioners. She likewise admitted the regent to an audience; who, encouraged by the assurances of Elizabeth's protection, laid aside his reserve, and charged the queen of Scots with being accessary to the contrivance and execution of her husband's murder. The earl of Lennox, supporting this accusation, craved vengeance for the blood of his son.

But Elizabeth wished to obtain evidence, and Murray produced some love-letters and sonnets from Mary to Bothwell, containing proofs of her guilt. Mary's commissioners endeavoured to change the inquiry into a negotiation; but finding it impracticable, they broke off the conference without making any reply. Having obtained these evidences, Elizabeth issued orders for her removal to Tutbury. She wrote to her as if the presumptions of her guilt had amounted to proof; in hopes, but in vain, of constraining her to confirm her resignation of the crown.

The proceedings were now ended, and Elizabeth resolved to detain Mary a prisoner in England, hoping that the proofs of her guilt would apologize for the severity of her treatment. The regent, before his departure, had an audience of Elizabeth, who assured him of her favour and support, but declined acknowledging the young king of Scots, or treating with Murray as regent of Scotland. Mary recriminated upon the regent, by accusing him of having devised and excited the murder of the late king, and endeavoured to raise her adherents in Scotland. She caused a report to be circulated, that Murray had agreed to convey the young prince into England, to surrender the fortresses in Scotland, and to acknowledge the superiority of England. To counteract these reports, Elizabeth published a counter-proclamation.

With the view of strengthening the queen's party, the court of France sent over the duke of Chatelherault to Scotland, and Mary invested him with the authority of her lieutenant-general in Scotland, together with the title of her adopted father. An accommodation was effected between the hostile factions, although Argyll and Huntly refused to be included in the treaty. The regent commanded his guards to seize the duke of Chatelherault and Lord Herries, and imprisoned them in the castle of Edinburgh. A blow so decisive, produced immediate tranquillity.

The duke of Norfolk now openly avowed his design of marrying the queen of Scots; but he was committed to the tower, and Mary was removed to Coventry, where her imprisonment was rendered more painful. These transactions were succeeded by an attempt to restore the qeeen of Scots by force of arms. The earls of Northumberland and Westmoreland had warmly espoused her interest, and were encouraged by a promise of money and troops from the king of Spain. But Elizabeth concerted her measures with so much vigour, that the chiefs of the conspiracy fled to Scotland, and the common people dispersed. Elizabeth now opened a negotiation with the regent, for delivering Mary into his hands; but the French and Spanish ambassadors remonstrated, and the project was abandoned by the sudden death of the regent, who was assassinated at Linlithgow by Hamilton of Bothwellhaugh. A.D. 1570.

On the death of the earl of Murray, the queen's party seemed for a while to triumph. At length, by the recommendation of Elizabeth, the earl of Lennox was chosen regent. After being tantalized with the hopes of liberty, Mary found herself under stricter custody than ever. Conceiving herself abandoned by the court of France, she corresponded with Philip of Spain, who supplied herself and her friends in Scotland with money.

A scheme for rescuing Mary, and overturning the English government, was concerted by the bishop of Ross, the Spanish ambassador, and Ridolphi, an agent of the pope. It was proposed, that the duke of Alva should land 10,000 men in England; that the duke of Norfolk, who had renewed his engagements with Mary, should join his friends, together with the English catholics; and that the combined forces should march to London, and oblige Elizabeth to submit to whatever conditions they might impose. But the English nation was delivered from the threatened danger by the discovery of the plot to Lord Burleigh.

The unfortunate queen of Scots, who had been the remote cause of these commotions, was treated with greater severity; and no person was permitted to see her but in the presence of her keepers. The English commons voted an address to Elizabeth, praying that Mary might be tried and capitally punished. The state of her affairs in Scotland was very unpromising. Dumbarton castle, the only fortress in the kingdom that owned her authority, was surprised and taken by Captain Crawford of Jordanhill.

Crawford seized in it the archbishop of St. Andrews. A.D. 1571. He was carried to Stirling, and, as he had been formerly attainted, was, without any formal trial, executed. This enraged the queen's party, and Kirkaldy, the governor of Edinburgh castle, seized the metropolis, and issued a proclamation denouncing the authority of the regent as usurped and unlawful. Huntly, Home, and Herries, assembled with their followers at Edinburgh, which they garrisoned. The factions which divided the kingdom were both influenced by religious considerations. The prince's adherents defended his authority as the best support of the protestant religion; the queen's partisans hoped, by her restoration, to re-establish popery; and the nobles, who respectively adhered to them, assembled in different parliaments. Only three peers and two bishops assembled in the queen's parliament; and they passed an act, attainting two hundred of the prince's friends, who were assembled at Stirling, where Lennox and his partisans were surprised in the heart of the town. The earl of Mar, with only thirty soldiers, sallied out and fired upon the enemy. The townsmen armed themselves, and joined, when the assailants, in their turn, surrendered themselves, and the regent fell a sacrifice. Mar was elected to the regency, and concluded a truce with the queen's party, by means of the French and English ambassadors: but he shortly died, and was succeeded by the earl of Morton, who acted in concert with Elizabeth.

The captive queen's influence rapidly declined in both kingdoms. Her partisans in Scotland were glad to submit to the king's authority, and accept of an indemnity for all past offences. Still the nobles were divided into factions; and finding his situation untenable, Morton resigned his authority into the hands of the young king, who, though but eleven years of age, assumed the administration.

The count d'Aubigney was dispatched to Scotland by the duke of Guise, in order to detach James from the English faction. He gained the affection of the young monarch, and, notwithstanding his remonstrances, Morton was arrested, accused as an accomplice in the late king's murder, and condemned to suffer as a traitor. He admitted that Bothwell had communicated to him the atrocious design; but pleaded that the queen had acquiesced and desired his concurrence, and denied that he had ever expressed any approbation of the murder. Apprized of Morton's condemnation, Elizabeth interceded in his behalf, and ordered a military force to the borders. But those measures served only to hasten his execution.

The influence of the royal favourites over the young king was such, that a conspiracy was formed for seizing James's person. A convention of estates, and an assembly of the church, were convoked to ratify the security of the conspirators. A protracted and fruitless negotiation for Mary s release and restoration to a limited authority, was opened between the French and English ambassadors; but the privy council rejected all treaty of accommodation. James made his escape to St. Andrews, where he summoned his friends to attend him. Argyll, Montrose, and Rothes, hastened to pay their duty to their sovereign; while the conspirators, Angus, Hamilton, Mar, and Glammis, fled to England, and were protected by Elizabeth. The earl of Gowrie was kept in prison, and on some new accusation, was condemned and executed. Arran and his violent conduct soon rendered the party of the exiled lords popular. Being assisted by Elizabeth, they made two successive attempts on Stirling castle, whether the king had fled for refuge, and prevailed. They obtained pardon soon after, and were re-instated in their honours and fortunes, while the royal minions were dismissed. Arran was degraded; and Elizabeth, pleased with this change, maintained a correspondence with the new ministry of James. The more effectually to accomplish her purpose, she prevailed upon him to accept of a pension, and a treaty of mutual defence was also concluded.

The rigorous restraints imposed upon the captive queen of Scots, pushed her into enterprises which threatened the repose of Elizabeth. The English seminary at Rheims had wrought themselves to a high pitch of rage against Elizabeth, and regarded her assassination as the most meritorious of enterprises. For this purpose John Savage was sent over to England, and John Ballard, a priest of Rheims, formed the project of dethroning her, and restoring the catholic religion in England. Anthony Babington, to whom Ballard disclosed his intentions, had been persuaded to interest himself in Mary's deliverance; and he was recommended to the captive queen as a person worth engaging in her service. Encouraged by his ready acquiescence, Ballard discovered to him the design of Savage, and proposed to join five others with him in the desperate undertaking. Babington successfully employed himself in increasing the number of his associates, and drew into the conspiracy many discontented catholic gentlemen. On the same day that Elizabeth was to be assassinated, Babington proposed to rescue Mary from her guards.

These designs were detected by Walshingham; but the extent of the ramifications was not fully discovered till Gifford, a priest, came over to make him a tender of his services. Babington and his associates engaged this priest to communicate their designs to the captive queen, and Mary expressed her approbation of the exertions of her friends, assuring them of reward. These letters were carried by Gifford to the secretary, and were deciphered.

Ballard was apprehended; the other conspirators were speedily discovered and thrown into prison. The leaders made a full confession, and fourteen were condemned and executed. Elizabeth now determined to bring Mary to a public trial, as being accessary to the conspiracy. Her papers were accordingly seized, her principal domestics arrested, and her two secretaries sent prisoners to London. Forty commissioners, with five other judges, were sent by the English court to Fotheringay castle, to hear and decide this cause.

Mary protested against the authority of the commissioners, but was persuaded to appear to hear and to give answer to the accusations that should be preferred against her; but she still refused to acknowledge the jurisdiction of the court. The chancellor vindicated his authority, by pleading the supreme jurisdiction of the English laws over every one who resided in England.

The crown lawyers proved that she had allowed herself to be addressed as queen of England; that she had corresponded with some noblemen, in the view of engaging the Spaniards to invade the kingdom; that she had proposed to transfer her right to the crown of England to Philip of Spain, should her son refuse to become a catholic; and that she had concurred in the design of assassinating Elizabeth.

The chief evidence against the queen arose from the declarations of her servants. She demanded that they should be confronted with her; and concluded with the most solemn denial of having ever entertained or concurred in the illegal design against Elizabeth's life. Her objections were over-ruled, and her requests evaded.

Having finished the trial, the commissioners adjourned to the star chamber, where they delivered their verdict of guilty against Mary. Sentence of death was then pronounced against the captive queen; but a declaration was published on the same day by the judges, that "this sentence did nowise affect or derogate from the title and honour of James, king of Scotland, and that he was in the same place, degree, and right, as if the sentence had never been pronounced."

Notwithstanding Elizabeth had now brought affairs with Mary to that crisis which she had long ardently desired, she felt a reluctance to execute the sentence, resisted the solicitations of her ministers, and affirmed that her people's safety only induced her to hesitate a moment in pardoning all the injuries she had received from the queen of Scots.

That the execution of the sentence might appear to be the general wish of the nation, Elizabeth summoned a new parliament, which unanimously voted an address, praying that the sentence might be executed without delay; and this resolution was published by proclamation. No sooner was Mary's sentence generally known, than great efforts were made by foreign princes to prevent its execution. The young king of Scots wrote a letter to Elizabeth, remonstrating against the injustice of the whole procedure. The Master of Gray and Sir Robert Melville were dispatched to enforce the remonstrance, and to accompany their arguments with menaces.

In order to alarm the English, rumours were circulated that the Spanish fleet was arrived at Milford-haven,—that Mary had escaped from prison,—that a conspiracy was formed to assassinate Elizabeth and burn London. Elizabeth ordered her secretary to draw out privately the warrant for Mary's execution. She signed it, and then commanded him to carry it to the chancellor, in order to have the great seal appended to it. Next day she countermanded that order; and when informed that the warrant had already passed the great seal, she appeared to be moved, and blamed her secretary's precipitation. The privy council, being informed of the whole transaction, persuaded Davidson to send the warrant to the earls of Shrewsbury and Kent, who were commanded to see it executed.

The earls went to Fotheringay castle, informed Mary of their commission, and desired her to prepare for death by eight o'clock next morning. She replied, that she did not expect that the queen her sister would have consented to her death, or have executed the sentence against a person not subject to the laws and jurisdiction of England. "But as such is her will," said she, "death, which puts an end to all my miseries, shall be to me most welcome; nor can I esteem that soul worthy the felicities of heaven, which cannot support the body under the terrors of the last passage to the blissful mansions.

Mary was executed on the 8th of February 1587, in the forty-fifth year of her age, and the nineteenth of her captivity in England.

When queen Elizabeth was informed of Mary's execution, she affected the greatest surprise and concern. She asserted that Mary had been put to death without her knowledge, and against her inclination. Under the pretence that he had exceeded his commission, Davidson, her secretary, was fined ten thousand pounds and imprisoned.

These appearances were assumed, to appease the young king of Scotland, who publicly avowed his determination to employ the whole force of his kingdom in order to avenge his mother's death. He recalled his ambassador, and refused an audience to an envoy who had been sent with a letter of condolence and apology from Elizabeth. Many of his nobles advised him to take up arms without delay; and the catholics recommended an union with Spain. After allowing James to vent his grief and anger, Elizabeth employed emissaries to induce him to forbear hostilities; and he fell into a good understanding with the court of England. Such was James; such was the Scottish nation. Which was most spiritless and most base, posterity may attempt to settle.

The safety of Britain, and the preservation of the reformed religion, required the steady co-operation of the Scots and English. Philip of Spain projected, not only the invasion, but the conquest of England. Both Elizabeth and Philip endeavoured to secure the alliance of the king of Scots; and, in a convention of the nobles, he avowed his resolution of acting in concert with Elizabeth against the common enemy, and offered to send an army to her assistance.

James's zeal was nobly seconded by the devotion of his subjects; and a bond was framed and subscribed by the nobles, the clergy, and the people. The Spanish armada at last sailed, but continual disasters attended its course. Tremendous storms and successive battles combined to frustrate its object; and not one half of the fleet returned to Spain.

A.D. 1588.

Disappointed in his expectations of conquering England by a naval armament, Philip proposed to transport a body of troops to Scotland, whence he hoped to make a successful attack upon England. In order to accelerate his design, he remitted a sum of money to be distributed among the Scottish nobles most zealous for popery. In consequence, the earls of Huntly, Crawford, Errol, and Bothwell, offered six thousand men to make him master of the kingdom. These treasonable designs were detected by Elizabeth's ministers. James was inclined to soothe rather than to irritate the catholics; and a short imprisonment was the only punishment inflicted upon Bothwell and his associates.

The royal clemency was ungratefully requited by the delinquents, who soon after attempted to seize the king's person. But Maitland disconcerted their machinations, and they retired to the northern parts of the kingdom; where, being closely pursued by a force under the king in person, they surrendered, and threw themselves on his mercy. They were tried and convicted of treason; but James, agreeably to his usual policy, confined them a few months and then set them at liberty.

The king's marriage was an event which the Scots desired, and he had made overtures for that purpose to the eldest daughter of the king of Denmark. But Elizabeth, desirous to prevent every incident that might render the accession of the king of Scots more acceptable to the English nation, artfully corrupted his ministers, and the Danish monarch wedded his daughter to the duke of Brunswick. James then paid his addresses to her younger sister, the princess Ann; and an embassy was immediately sent by the Scottish court to Denmark. The articles of marriage were settled; the ceremony was performed by proxy; and the princess embarked for Scotland. But her fleet was driven by a storm on the coast of Norway. James encountered the perils of a voyage across the North Sea, in order to conduct his bride home; and, after spending the winter in Copenhagen, he returned home and was joyfully received by his subjects.

Marriage of James and Ann of Denmark.

A.D. 1591.

The policy of the kingdom was at that time in a miserable condition. The fierce and untractable spirit of the nobles occasioned numerous and mortal quarrels. Assassination and murder were perpetrated with impunity. The ignorance of the times is exhibited in the general belief in sorcery and witchcraft. Many ignorant persons, accused of using incantations, were punished without mercy. Bothwell was committed to prison, but he soon made his escape. Imputing the king's severity to the personal enmity of the chancellor, he assembled his followers, to be revenged. He had nearly accomplished his purpose, when an alarm was given to the citizens of Edinburgh. Bothwell fled. A royal commission was issued, impowering the earl of Huntly to pursue and punish the fugitive; but Huntly, intent on gratifying his private revenge, slew the earl of Murray, and burned his house to the ground. The murder of the regent Murray's son, excited general indignation. The citizens of Edinburgh rose in a tumultuous manner; and, to escape the popular fury, James retired with his court to Glasgow, where Huntly surrendered himself, but escaped with impunity. Such a dereliction of public duty rendered the king's administration very unpopular. To conciliate the favour of the people, James lent an ear to the complaints of the presbyterian clergy, and courted

History.

A.D. 1592. their favour. Thus was the presbyterian church, with its discipline and judicatories, for the first time established by law.

The tranquillity was soon interrupted. Bothwell suddenly appeared at Falkland, and unsuccessfully attempted to seize the king's person. A more dangerous conspiracy was discovered soon after. The earls of Angus, Errol, and Huntly, had entered into an agreement with the king of Spain, for the re-establishment of the Catholic worship in Scotland, and for effecting the same purpose subsequently in England. George Ker was intimidated by the torture to make a full disclosure of the conspiracy. Graham of Fintry, and Barclay of Ladyland, whom he accused as accomplices, were taken into custody, and corroborated his evidence. All ranks now stood forth for the liberty and independence of their country. Angus was committed to the castle, Graham was tried and beheaded. Errol and Huntly were summoned; but they fled to the mountains. James marched into the north, placed garrisons in the castles of the contumacious barons, and appointed the earls of Athol and Marischal to maintain the public peace.

A.D. 1593. The poverty of his finances was a subordinate cause of the impotence of James's government. The court was divided into two factions, under the queen and the chancellor. To attain the ascendency, the queen's party recalled Bothwell. He received a pardon; but parliament refused its sanction. He now fled to England, where he was secretly protected by Elizabeth.

Though the prosecution of the Catholic earls was suspended, the parliament at length passed an act of attainder

A.D. 1594. against them, and they agreed, upon certain conditions, to leave the kingdom. Bothwell being detected as an accomplice, forfeited the protection of Elizabeth, and took shelter first in France, and then in Italy, where he died.

Discord now broke forth between the king and the presbyterian clergy. The general assembly appointed a day for public fasting, and settled a deputation, which importuned the king to confiscate the forfeited estates of the exiled lords. But James dreaded the consequence of exasperating a faction so powerful, and was therefore inclined to mitigate their punishment, and permit them to return home, to which the convention consented. On this the assembly's committee remonstrated, and their representation being disregarded, they wrote circular letters to all the presbyteries in Scotland, enjoining every clergyman to publish the anathema of the church against the popish lords, and encouraging them to stir up the nation in defence of their religion.

A convention met at Edinburgh, under the name of the standing council of the church; and the king could not conceal his indignation at conduct which he considered an invasion of his prerogative, and an approximation to rebellion.

A.D. 1596. The intemperate zeal of a clergyman hastened the crisis. Black, a minister, inveighed from the pulpit against the recent measures of the government. The English ambassador complained, and Black was summoned to answer before the privy council. He refused to obey; appealed to the judicatories of the church; and, enraged at his contumacy, the king sentenced him to be banished beyond the river Spey, and avowed his determination to compel the clergy to submit to the jurisdiction of the civil courts for all offences against the laws of the realm.

The opposition which the king made to the proceedings of his opponents, was represented as an evidence of his apostasy. The king was led to believe that the citizens of Edinburgh assembled clandestinely for military training. The ministers were alarmed by a report, that the king was under the secret influence of the catholic lords. Disorder and tumult succeeded. The multitude voted a petition to the king, praying for a redress of ecclesiastical grievances, and for the removal of obnoxious counsellors. A deputation of noblemen, ministers, and burgesses, presented it in the presence of the Court of Session. But the king declined receiving the petition, and retired. The multitude gave way to rage, called for arms, threatened the king and his courtiers with instant death; but the magistrates succeeded in quelling the tumult. James withdrew to Linlithgow. The courts of law were ordered to follow, and the nobility and gentry were ordered to return home. The clergy used all their address to counteract the royal mandate, inflamed the minds of the people by violent invectives against the government, and represented the necessity of an immediate association for mutual defence. Lord Hamilton was solicited to become the leader; but he apprized the king of the hostile design. A peremptory order was sent to Edinburgh to seize and imprison the ministers; and the clergy absconded.

The affair was laid before a convention of the estates, by whom the ministers and their coadjutors were pronounced guilty of treason; and it was enacted, that every clergyman should be obliged to subscribe a declaration, acknowledging the royal authority as alone competent to prosecute and punish all offences civil and criminal. Magistrates were commanded to apprehend those ecclesiastics who should utter in their sermons indecent reflections upon the king's conduct. Edinburgh was declared to be disfranchised; but, through the intercession of Elizabeth, he became reconciled to the delinquents, and absolved them from the penalties of law. Though the king had gained an undisputed ascendency, he pursued his advantage with moderation, but address. The greater part of the reformed clergy were indigent, and, as their poverty generated discontent and envy, he conceived the design of exciting the jealousy of the unprovided clergy against their beneficed and more dignified brethren.

The proceedings of the General Assemblies convened at Perth and Dundee, evince how effectually they were brought under the king's control. Many points of discipline were voluntarily abandoned, the licence of declaiming on the measures of the government from the pulpit was censured, and the patronage of the most populous districts was vested in the crown. The exiled lords were restored to the church, and were reinstated in their honours and fortunes. James secretly pursued the commission of the Assembly to petition parliament, that the presbyterian clergy might be there represented, as in the time of the popish hierarchy, to watch over the interests of the church.

This excited violent debates between the Assembly and the subordinate ecclesiastical courts; but it was finally decided, and fifty-one ministers were nominated by the king to the vacant benefices, which entitled the incumbents to a seat in parliament, from lists presented by the Assembly.

The discontent occasioned by this innovation, was aggravated by the appearance in Edinburgh of a company of players, and James, who had been formerly suspected of popery, was now indirectly charged with infidelity. An act was passed by the kirk-session of Edinburgh, declaring it to be scandalous to resort to the theatre; but as the king resented this interference, the ministers judged it prudent to yield to his authority, and the obnoxious statute was repealed.

A season of domestic tranquillity seemed to dawn on the nation. But the political horizon was suddenly overcast by a tempest which destroyed the house and fortunes of the noble family of Gowrie. As the king was preparing himself for the chase at Falkland, Alexander Ruthven, second brother to the earl of Gowrie arrived and informed the king that he had apprehended a stranger of very suspicious appearance, possessed of a great quantity of foreign gold. James proposed to send a warrant to the magistrates of Perth to detain and examine the suspected stranger, and to report the result; but Ruthven earnestly entreated his majesty to accompany him in person and investigate the affair. About noon, the king hastily left Falkland in company with Ruthven. They were overtaken on the way by Lennox, Mar, and others, to the number of twenty persons.

Two messengers were successively dispatched by Ruthven to his brother to announce his majesty's approach. The earl of Gowrie in consequence rode to meet the royal party, and conduct them to his castle. While his attendants were dining in an adjoining apartment, Ruthven requested the king to accompany him whither the prisoner was secured. After following his guide through several apartments, the doors of which were successively locked as they passed, Ruthven opened the door of his small study, and the king was surprised and alarmed at the sight of a man armed with a sword and a dagger. Ruthven snatched the weapons and held the point of the dagger to the king's breast, reminding him of his injustice and cruelty to his father, and threatening him with instant death should he make any noise or offer resistance.

James expostulated, flattered, and threatened. Ruthven protested that his majesty should receive no injury if he would swear not to escape or raise an alarm, and was then given in charge to the armed man. Ruthven retired, and James prevailed on his keeper to open a window that looked to the street. Meantime, Lennox and Mar, impatiently inquired whither he had retired, and Gowrie replied that he had set off for Falkland. Ruthven had returned to the king, and offered to bind his hands. James replied, that he was born a free king, and should die a free king. Ruthven seized him by the throat, and a violent grapple ensued. The king dragged his opponent to the window, and shrieked for help. At that moment the lords were passing by, and, rushing into the castle, began to demolish every obstacle which prevented access to the king.

Sir John Ramsay stabbed Ruthven, and Sir Thomas Erskine and Sir Hugh Herries immediately killed him, notwithstanding his protestations of innocence. Erskine and Herries had no sooner joined the king, than Gowrie entered with two drawn swords and several attendants. The king's friends had presence of mind to thrust him into the study. Gowrie was pierced through the heart, and his attendants fled.

No sooner had the incidents transpired, than the burgesses of Perth, of which Gowrie was provost, surrounded the castle, and threatened the king and his followers with vengeance. James conciliated the multitude by detailing to them the particulars of his escape, and left Perth for Falkland. Of the different hypotheses that have been advanced to account for this mysterious and tragical event, none appears rational or satisfactory. The most probable solution is, that Gowrie had formed a design to seize the king's person, and by that means acquire the absolute direction of the state.

The news reached Edinburgh on the following day. The privy council issued an order to the ministers to offer public thanksgiving for his majesty's happy deliverance; but they declined giving publicity to a story which seemed to them problematical and dubious. Their incredulity was at last overcome by the terror of the king's resentment. Robert Bruce, less obsequious, was punished for his scepticism with the forfeiture of his benefice and banishment.

The parliament proceeded with great severity against the house of Gowrie. An indictment for high treason was preferred against the dead bodies of the murdered brothers, who were capitally convicted, their honours and estates forfeited, and the surname of Ruthven abolished. Three of Gowrie's servants were executed at Perth. James was now encouraged to prosecute the salutary undertaking of reforming the Highlands. It was his aim to render the turbulent mountaineers peaceful, and to lessen their attachment to military pursuits. The feudal chiefs were made responsible for the peaceable conduct of their vassals; and the laws for repressing idleness and restraining the predatory habits of the peasantry were commanded to be rigorously enforced.

A. D. 1602.

Three towns were ordered to be built, in Lochaber, Cantyre, and Lewis. But a colony that had been transferred from Fife to Lewis, was surprised and murdered, and obliged to abandon the settlement. For several years previous to Elizabeth's death James made many efforts to secure his accession to the English crown. Being allied by marriage to many German princes, he obtained from them an acknowledgment of the justice of his claim, and corresponded with the pope, who declared in his favour.

Elizabeth, apprised of this transaction, was induced to scrutinize his conduct towards the catholics, and this increased her indecision to nominate him as her successor. But these appearances were counterbalanced by an explicit assurance of support from the English Catholics, from many of the nobles, and from the queen's own ministers. The court of France attempted to throw obstacles in the way of this union; and though anonymous pamphlets were circulated unfavourable to the king's right, they were disregarded, and every religious and political party coalesced in promoting his accession. The time at length arrived, and after a reign of forty-five years, Queen Elizabeth expired in the seventieth year of her age.

Death of Elizabeth, and accession of James to the English throne.

In compliance with the wishes of her ministers, Elizabeth on her death-bed named the king of Scots as her successor. The news was communicated to James by the privy council at London. He caused his titles to be immediately proclaimed, and prepared to take possession of the English throne. On the Sabbath day before his departure, he went to the church of St. Giles, and addressed a long discourse to the audience, in which he enumerated the many proofs he had given his countrymen of affection and zeal, promising to revisit his native country every third year. He committed the civil administration of the kingdom to the privy council and the officers of state, and intrusted the guardianship of his children Henry, Charles, and the Princess Elizabeth to different noblemen. He commenced his journey for London on Tuesday the 5th of April, with a splendid but select train of the principal nobility, and entered it on the 17th of May.

A. D. 1603.

Statistics. Geography, political.

That we may condense a few of the important matters which may be considered as appertaining to, or connected in some way with the political geography of Scotland, we shall here throw them into the brief and convenient form of tables.

With respect to the principal towns, Edinburgh, Perth, Glasgow, &c. we may refer to our articles on those particular subjects, as we may to several of county and other articles for information so fully given that we need not repeat even a sketch here.

Thus also on the subject of our coal mines, appertaining to the department of commerce and manufactures, we may refer to our article MINES, as we may also for our canals to our article on inland NAVIGATION.

In conformity with the system adopted regarding the representation of the Scottish peerage, the 16 peers are elected for every new parliament, by the whole body of the peerage duly qualified to vote at the period when the election takes place, and are not, when once elected, continued for life, as is the case in regard to Irish peers by the recent union with Ireland.

The following table represents the diminution that has taken place in the numbers of the Scottish peerage since the union, and their amount at present.

Table of the Scottish Peerage.

Table of the Scottish peers.

1. Number of Scottish peers at the union,	154
2. The duke of Rothesay when entitled to vote,	1
3. Added by subsequent orders of the House of Lords, ...	4
	159
Of whom,	
1. Extinct or dormant, including the title of Solway, ...	41
2. Merged in, or united to other titles,	10
3. Forfeited, ...	26
But four lately restored, ...	4
Remain, . .	82
	86

Of these 23 (including the duke of Rothesay) are British peers, but who still retain the privilege of voting at elections, and even continue eligible.

At the election on the 13th November 1812, there were three minors, three peeresses, and two Roman Catholics, consequently eight disqualified from voting. The peers who actually voted were 52, and 22 were out of the kingdom or did not vote.

2. Parliamentary Representation of the Counties or Landed Property.

Parliamentary representation of the counties or landed property.

Scotland is divided into 33 counties, which are represented in parliament by 30 commissioners, or knights of the shire. The following table contains the amount of the valued rent in Scottish money, as it stood in 1674, and the number of freeholders or voters in each county. The number of freeholders must alter from year to year, according to the state of property, and various other incidental circumstances, as deaths, minorities, &c. The list here given is the latest, viz. the one drawn up for the year 1825. In 1811, the number was 2429, giving an increase of 637 in fourteen years.

Counties represented.		Valued Rent in Scotch Money.			No. of Freeholders in 1825.
1. Aberdeen		£235,665	8	11	180
2. Argyll		149,595	10	0	74
3. Ayr		191,605	0	7	187
4. Banff		79,200	0	0	36
5. Berwick		178,366	8	$6\frac{7}{24}$	126
6. Bute and	per vices	15,042	13	10	13
7. Caithness		37,256	2	10	24
8. Clackmannan and	per vices	26,482	10	10	16
9. Kinross		20,250	4	$3\frac{3}{8}$	23
10. Cromarty and	per vices	12,897	2	$7\frac{8}{12}$	18
11. Nairn		15,162	10	$11\frac{1}{4}$	19
12. Dumfries		158,502	10	0	62
13. Dunbarton		33,327	19	0	67
14. Edinburgh		191,054	3	9	170
15. Elgin and Moray		65,603	0	5	34
16. Fife		363,129	3	$7\frac{9}{12}$	246
17. Forfar		171,239	16	8	127
18. Haddington		168,873	10	8	105
19. Inverness		73,188	9	0	72
20. Kincardine		74,921	1	4	75
21. Kirkcudbright		114,597	2	3	143
22. Lanark		162,131	14	6[illegible]	175
23. Linlithgow		75,018	10	6	65
24. Orkney and Shetland		57,786	0	$4\frac{41}{100}$	50
25. Peebles		51,937	13	10	42
26. Perth		339,892	6	9	221
27. Renfrew		69,172	1	0	158
28. Ross		75,043	10	3	63
29. Roxburgh		314,663	6	4	139
30. Selkirk		80,307	15	6	35
31. Stirling		108,509	3	$3\frac{1}{12}$	131
32. Sutherland		26,093	9	9	23
33. Wigton		67,641	17	0	66
Total		3804,157	19	$2\frac{9}{24}$	3066

It is to be remarked, that six of these counties are represented in parliament by only three members; two of them united for that purpose, electing a representative alternately; and that the Shetland isles, owing to some defect regarding their valuation, though entitled to share in the representation of Orkney, have as yet no freeholders on the roll. Lands holding of the crown to the extent of £400 Scotch of valued rent, or, in particular cases, what is called a forty shilling land of old extent, entitle the proprietor to a vote, and those freeholders only are included in the above Table. There are in every county more persons who possess freehold property below, than such as have land either equal to, or above that valuation; and besides, the nobility are never put on the rolls of freeholders, whatever extent of property they may possess. This in some measure accounts for the number of freeholders being so low as 2429. Were there to be a voter for every £400 of valuation, the total number would be 9511. Lands holding of a subject-superior give no vote, whatever may be the amount of their valued rent.

3. Representation of the Boroughs.

The representatives of royal boroughs are limited to 15 in number, and are sent from the following towns:

1	From Edinburgh, including North and South Leith, and the West Kirk, or St. Cuthbert's parish, the population of the whole in 1821 was	138,[illegible]
1	From Jedburgh, Lauder, Haddington, Dunbar, and North Berwick, about	19,317
1	From Selkirk, Peebles, Lanark, and Linlithgow, ...	17,[illegible]
		164,758

Brought over	164,758
1 From Stranraer, Wigton, Whithorn, and New Galloway, ...	7,970
1 From Sanquhar, Kirkcudbright, Dumfries, Lochmaben, and Annan, ...	22,529
1 From Ayr, Irvine, Rothesay, Campbelton, and Inverary, ...	28,722
1 From Glasgow, Rutherglen, Renfrew, and Dumbarton, ...	157,767
1 From Stirling, Culross, Dumfermline, Inverkeithing, and Queensferry .	25,430
1 From Burntisland, Kinghorn, Kirkaldy, and Dysart, ...	15,560
1 From Anstruther-East and West, Pittenween, Kilrenny, and Crail, . .	6,067
1 From St. Andrews, Cupar-Fife, Dundee, Perth, and Forfar, ...	66,331
1 From Brechin, Arbroath, Montrose, Bervie, and Aberdeen, ...	67,949
1 From Kintore, Inverary, Banff, Cullen, and Elgin, ...	12,801
1 From Forres, Nairn, Inverness, and Fortrose, ...	20,603
1 From Dingwall, Tain, Dornoch, Wick, and Kirkwall, ...	16,917
15 Members from 66 towns. Total population	613,404

The above is the population of the boroughs, inclusive of country districts attached to some of the town parishes. The number of persons who actually vote at the elections is very inconsiderable, consisting in general of the magistrates and town-council of the different boroughs, and amounting to 20 in each burgh, or to 1320 in all.

State of Property in 1811.

	Number of Proprietors.
1. Large properties, or estates above £2000 of valued rent, or £2500 Sterling of real rent,	396
2. Middling properties, or estates from £2000 to £500 of valued rent, or from £2500 to £625 of real rent, ...	1077
3. Small properties, or estates under £500 of valued rent, or £625 of real rent, .	6181
4. Estates belonging to corporate bodies,	144
Total number of proprietors in Scotland	7798

The Poor.

1. Number of parochial poor in 1820	44,199
Average allowance to each . .	£2 11 8
Total expence .	£114,195 17 9
Sum which each pays . .	1 3

Proportion of paupers to the population 1 to 47.

Population.

	Year.	Number.	Increase.
1. Population	1755	1,265,380	
2. Ditto	1799	1,526,492	261,112
3. Ditto	1801	1,599,068	72,576
4. Ditto	1811	1,804,864	205,796
5. Ditto	1821	2,135,300	330,436

The average population of Scotland is at the rate of *seventy-two* persons per square mile.

Statistics.

Geography, political.

In 1818, there were	Blind .	1100
	Deaf and dumb	784
	Insane .	4650
		6534

Revenue of Scotland.

Revenue of Scotland.

1. Revenue at the union, 1707, .	£110,694		
2. Additional taxes then imposed .	49,306		
Total revenue at the Union	£160,000		
3. Revenue of Scotland, anno 1813, . . .	£4,843,229	12	11
4. Expence of management, drawbacks, &c. . .	639,132	5	2
5. Net revenue of Scotland .	£4,204,097	7	9
6. Increase since the Union	4,044,097	7	9

Physical Geography, general Distribution of the Land and Water.

Physical geography, general distribution of the land and water.

Scotland may, in the strictest sense, be considered a mountainous country, as it possesses very little of what may be called level land, except the alluvial tracts which attend the courses of its greater rivers. Yet there is a low country and a high, though the physical and political senses of these terms do not coincide. The low country forms a tract ranging from Inverness along the sea shore, as far south as Aberdeen or Stonehaven, where it terminates for a short space to be again renewed on a broader scale. The tract indeed, which, commencing by an eastern margin, extends hence to the Lammermuir range southwards, and then crosses westward to Glasgow, may be esteemed the proper lowland tract of Scotland, though even this affords little continuous plain country, being every where interspersed with hills, or interrupted by ridges.

The mountain land, or high country, is readily divisible into two distinct tracts. Of these the north-western forms the country of the Highlands, and the southern comprises the great pastoral district, commonly known by the term dales, the former seat of those borderers who once resembled the Highlanders in their warlike habits, and maintained an almost perpetual hostility with England.

The Highland mountains are separated from the middle and low district by a tolerably distinct line, which may be traced along their declivities, to which the very indefinite appellation, Grampians, has been applied. Commencing at the Mull of Cantyre, the boundary is the sea, and successively the Clyde, until we reach Dunbarton. Hence, and omitting the minuter details, it may be conceived to pass through Callander, Crieff, Dunkeld, and Blairgowrie; after which it ranges along the north side of the great plain of Strathmore, till it is lost near Stonehaven. Hence northward, the boundary of the mountains is much less easy to mark, whether in description, or on the ground itself, from the irregular manner in which the ridges terminate in the lower lands. Neither is it necessary to do so in this general view.

The northern boundary of the southern mountain district is less marked; but, in a general way, it may be conceived to commence eastward with the Lammermuir ridge, passing along the Pentlands to Tinto, Hawkshaw, and Loudon Hill, and then turning southward by Wardlaw, Dalmellinton, and Larg Fell, so as to terminate near Creetown, in Galloway. Thus it leaves a considerable tract of irregular low country to the westward.

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* See our article Population, Vol. XVII. p. 96.

But the middle district is, as we remarked, rendered occasionally hilly by ridges and distinct elevations. One of the chief of these is the great Sidlaw range, which, commencing about Arbroath, stretches away to Perth, where it may be conceived to be continued in the Ochils, and subsequently in the Campsie hills, till that unites at Dunbarton to the mountains of the Highlands. The northern shore of Fife may be considered a portion of this ridge, and the remainder of that county is irregularly undulated by eminences, of which the Lomonds are the most remarkable. Similar scattered elevations and irregularities are found in the opener tract which, commencing at Dunbar, terminates at Greenock, or may be supposed continued round by the west coast to the Mull of Galloway. A thousand feet may be taken as an average of the greatest altitudes of these hills.

Distribution of the Mountains in the Highland Districts.

Distribution of the mountains in the Highland districts.

Though the best maps, and Mr. Arrowsmith's among others, represent the Highland, or north-western mountains, as disposed in ridges, and though chains are familiarly spoken of, that is not the character of the country. It must rather be considered an irregular mass of mountains, a great table land of hills thrown together without any determinate or predominant disposition.

The only thing which could give any colour to this imaginary fact, is the disposition of the land on the sides of the great Caledonian valley, the Glenmore na Albin; but even here the boundaries cannot be considered as mountain chains or ridges. The ridges, which are represented as attending the course of the Findhorn, that of the Spey, and that of the Dee, are almost equally fictitious, though certain small portions in various parts of the country may claim this denomination.

Such ridges will be found, sometimes attending the course of a river, more frequently the valley of a lake. Thus Loch Earn may be conceived to lie between two ridges, and the same might be thought of Loch Tay, Loch Tumel, Loch Ericht, and others, though, when the ground is itself examined, the exceptions will be found such as so deprive most of the apparent chains of any real claims to this denomination.

It will be seen also, that the apparent ridges do not follow the courses of the rocks themselves, or the bearings of the stratification. The general tendency of this, with no essential exceptions, is on lines which may be conceived to vary from the north-east to the north north-east. But even the apparent ridges do not all follow this course, presenting very various tendencies.

The courses of the vallies which contain the greater lakes may here be taken as examples, since it is by these that the apparent ridges are best indicated. Thus Loch Long tends to the north north-east, while Loch Lomond in its immediate vicinity is directed considerably to the westward of north; and the course of Loch Cateran, not far off, is not much to the northward of west. Of the four lakes, Loch Earn, Loch Tay, Loch Rannoch, and Loch Ericht, all lying on the same meridian nearly, and at inconsiderable distances from each other, the southernmost, Loch Earn, lies nearly east and west. The course of Loch Tay, the next, is north-east, and that of Loch Rannoch is due east. And here, in particular, the shape of the high land is strongly contrasted to the supposed north-easterly bearing, as this valley may be said to commence in the sea at Loch Leven, stretching across the moor of Rannoch so as to include that lake, and also Loch Tumel, and not terminating till it is cut off by the north and south valley which conducts the Tumel into the Tay. The last of these lakes, Loch Ericht, holds a north north-east course, parallel to the Glenmore na Albin.

This confusion is even more apparent, if we examine from Loch Lomond westward. The two branches of Loch Long, one of which forms Loch Goyl, have different tendencies; and Loch Eck is nearly at right angles to Loch Fyne, to which it approximates. The great ridge of Cruachan, which conducts at its foot the exit of the Awe, is at right angles to those which bound Loch Awe, as well as to Loch Etive; and the course of Loch Etive itself is discordant.

If we examine the sea lochs of the west, and the islands, the same uncertainty of position will be apparent, though, to the southward, the tendency is very regular, and according to the courses of the stratification. Thus the lochs from Loch Tarbet to Loch Craignish hold an accurate north-easterly course; but after that these positions become uncertain and contradictory. The first division of Loch Etive tends due east, and so does the general course of Loch Sunart. The same may be said of Loch Morrer and Loch Nevish; while the first branch of Loch Hourn lies to the south-east, as does Loch Duich. Here also the intricacy of the ridges is very striking, because Loch Long, which branches from this, has a course of somewhat more than a right angle from it. At Loch Torridon, the ridges of hills, and the consequent direction of this very deep inlet, is due east; and after this the positions become almost invariably the exact reverse of the course of the strata and of that tendency which is so strongly marked by the Glenmore na Albin. Loch Maree, both the Loch Brooms, Loch Assynt, Loch More, Loch Inchard, and all the accompanying smaller fresh water lakes and inlets, tend invariably to the south-east, and such is also the very distinct courses of the ridges, as far as they hold any courses.

This reverse tendency of the country is peculiarly marked in that immense though somewhat intricate valley, which crosses the whole of Sutherland, from the western to the eastern sea. This commences westward at Loch Laxford, and holding its course through Loch More, Loch Merkland, and Loch Shin, terminates in the eastern sea at the firth of Dornoch, forming a total length of more than eighty miles, and in a south east direction. Thus it crosses the course of the great Caledonian valley at right angles; while it possesses about the same length, and is very nearly on a similar level throughout; the altitude which separates the very few waters that run west, being very little elevated above that which distributes the great body of water eastward.

Here, could it be of any use, is afforded a certain facility for a water communication through Scotland; the quantity of land to be traversed being very small in proportion to the great extent of navigable water, or of land that, under other circumstances, which can never occur, might be rendered navigable.

We need only further remark, respecting this part of the mainland, that even in the vicinity of this prolonged valley, the courses of the ridges which determine Loch Eribol, the lochs of Tongue, and of Duirness, and the courses of the Naver and the Hallodale, are north.

Such is the irregularity of distribution which marks the mountains of the Highlands, as determined by the courses of the lakes and some of the greater vallies. But those of the rivers, while they mark the courses of the valleys, determine also the directions of the bounding hills, and indicate an equal uncertainty in the distribution of the higher lands.

The courses of the Nairn, the Findhorn, and the Spey, are those which principally indicate that conformity of the ridges to the stratification which is so strongly marked by the Glen More. But, as we just remarked, the northern rivers of Sutherland run due north, while the Brora, the Helmsdale, the water of Shin, and others, tend to the south-east, together with the Oikel, among the larger and more extensive, and the Glas, the Conan, and many more, among the smaller. Farther south, we find the Don running a long course to the south-east, and the Dee meeting it with an easterly one, while the Tay, with its several branches, receiving the Tilt, the Garry, the Tumel, the Almond, the Isla, and the Earn, combines within itself a discordancy of course which marks the equally irregular tendency of the valleys and ridges which conduct and accompany its waters.

It is unnecessary to illustrate this part of the physical geography of the Highlands further, by pursuing the Forth, with its various tributaries, or the smaller streams, which equally indicate the uncertain and varying distribution of the hill lands. If a north-easterly bearing in the ridges is seen in some parts very conspicuously, this is overwhelmed by a multitude of exceptions; and if we can sometimes trace ridges, or the indications of them, somewhat prolonged, the number of short and indeterminate ones put it out of our power to describe the mountains by ridges, and completely demolish the notion of chains of hills.

Outline of the Coast in the Highland Districts.

Though the general tendency and the prolongation of the interior ridges of mountains in the Highlands is very irregular and deficient, the outline of the coast accompanies, though with many striking exceptions, the general bearing of the stratification, and, in some remarkable instances, varies with the variations of this.

Commencing with the Mull of Cantyre, the tendency of both the eastern and western shores is nearly north. At Oban it begins to incline to the eastward, and the prolongation of this line may be conceived to be through the Glenmore na Albin. Thus far the stratification might appear to be coincident with the outlines; but although this is true in the Glen More, it is not so to the south of Oban, where it lies obliquely to the coast line.

If now from Oban we take up the coast from the point of Morven, it will be seen that this line is nearly at right angles to the north-eastern tendency, which is however resumed in a general manner from Ardnamurchan to Cape Wrath, though the total outline of this portion deviates but by two or three points from the north. The boundary of the north shore of Sutherland and Caithness deviates, on the contrary, by as much from the east, forming at Cape Wrath nearly a right angle; whereas, at Duncansbay head, the direction, in a general view, becomes, once more, that of the Glen More, which is always the standard. From Fort George to Kinnaird's head, the line is again east, after which, with some vacillation and irregularity, it may be conceived to be renewed even to the Tay, in a line laterally coincident with the standard. Thus the total outline of the coast, in a certain limited sense, may be conceived as regulated by the positions of the rocks, or by the course of the stratification.

General Distribution of the Southern Mountain Land.

General distribution of the southern mountain land.

The sketch already given of the middle district will suffice for the account of its distribution. That of the southern division is so irregular as scarcely to admit of any arrangement; and though represented as consisting of mountain ridges and chains, it must also be considered, as far as it is hilly, as forming an irregular assemblage of hills, or an elevated table land, with intervening valleys.

The predominant tendency, however, of these valleys, and consequently of the ridges, if they may so be called, is to the south-eastward; and as there are few lakes, they are traced by the courses of the rivers. If we commence with the Tweed, its predominant course is eastward; but at Coldstream it turns to the north-east, though there is no peculiar elevation of the land to mark out this course. The courses of the Esk, the Annan, the Nith, the Urr, the Fleet, the Dee, and others, is to the south and the south-east; and their prolonged valleys here mark distinctly the general courses of the hills, less easily traced by any other marks in a country where there are few elevations decidedly overtopping the general mountain land. But as far as it is possible to carry on general lines of elevation, such as they actually are found on the ground, and not in false maps, it will be seen that these are extremely intricate, and bear no general tendency of any kind. In this district of Scotland also, the fundamental cause of ridges is either wanting, or not to be traced, as the stratification of the rocks is irregular or unassignable.

Hence, also, there is nothing in the outline of the coast to require particular notice. It is not only irregular, but there is nothing in the general stratification which could have influenced its tendency.

Mountains.

Mountains.

The elevations of the Highlands are deserving of this title, according to the vague criterion by which these are generally distinguished; while those of the southern district, with few exceptions, cannot be reckoned beyond the class of hills.

The loftiest continuous range of land in the Highlands, and consequently in Britain, is that which bounds the Dee to the northward and eastward, near its sources, which, in fact, form the springs and feeders of this river. In this prolonged mass or ridge, the great elevations are Ben muc dhu, Ben avon, Ben y bourd, Ben chowin, and Cairn gorm. The general altitude of these averages to about 4000 feet, but Ben muc dhu is the loftiest point, and is indeed the highest land in the island.* Among contending altitudes, after this, we need not attempt to take any particular order; but Lochan na gar, to the south of the Dee in the same vicinity, is a rival mountain.

Proceeding from the same point, the great ridge of Ben y gloe ranks among the loftiest; and its highest summit, Cairn Gower, is one of the chief of the Highland mountains. Thus we are conducted to Ben Aulder and Ben Vualach, including Loch Ericht, and a neglected portion of that which unquestionably forms the most elevated tract of the whole country. If these have not yet been measured, their comparative altitudes can be conjectured with tolerable, or with sufficient certainty for the present purpose, by common levelling.

To the southward, Ben Lawers, exceeding 4000 feet, is the parent and beacon of a very lofty tract of mountain land, to which Ben More, Ben Vorlich, and other mountains farther to the south and west, may be considered to belong. In a similar manner, Schihallien, ranging to about 3000, is the loftiest summit of that mass of mountain which bounds Loch Tumel and Loch Rannoch to the south, and extends westward till it nearly meets the hills of Glenco and Loch Etive.

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* See our article PHYSICAL GEOGRAPHY, Vol. XVI. p. 483.

If we proceed farther westward, we find Ben Lomond, the most visited, if not the most celebrated of our mountains: itself exceeding 3000 feet, and surrounded by a crowd of hills of minor note, together with the more marked and conspicuous elevations of Ben Ledi, Ben Venu, Ben Vorlich, and the fantastical Cobler, or Arthur's Seat. Beyond this, in the districts of Cowal and Kerry, there is no mountain so conspicuous as to deserve distinction; the whole, even to the Mull of Cantyre, being a heap of mountains with scarcely an intervening valley, unmarked by any character, if we except that group of which Argyll's bowling green is the most remarkable.

Hence, northward, the first mass of mountain which attracts attention is the lofty ridge of Cruachan, attaining an average elevation of nearly 4000 feet, and conspicuous equally for the sharp peak of the parent hill. The whole of this group must, however, be considered as intersected by Loch Etive, and as comprising the remarkable elevations which bound Loch Creran and the southern side of Glenco. Among these, Buachaille Etive is peculiarly conspicuous, as well for its altitude, emulating that of Cruachan, as for its elegant sharp peak; the whole of this group being formed of granite, like the mountains of the Dee and of Loch Ericht. All those to the southward already enumerated are formed of micaceous schist, while the ridge of Ben y gloe consists chiefly of gneiss and quartz rock.

Ben Nevis now becomes the leading summit of another elevated tract, which extends from it to Loch Ericht and to the course of the Spey. From its position, rising immediately out of the sea level, and from its partial independence and supereminence, it is unquestionably the most conspicuous mountain in Scotland, and has long borne the honours of absolute preeminence, which, however, it must now yield to Ben Muc Dhu. The group to which it belongs is entirely separated from that of Cruachan, and from the ridge of Schihallien, which may be considered as continuous with this, by that very singular tract the moor of Rannoch, a plain or rather a collection of rocks, lakes, and bogs, elevated about 1000 feet above the sea. The total tract, from this to Loch Eil on one side and to Loch Laggan on the other, constitutes by far the wildest part of all Scotland; being totally uninhabited, and scarcely accessible in any part. Much of it has never been trod by human foot, and a large portion is entirely worthless.

If we proceed northwards to Inverness along the course of the great valley, and thence diverge eastward, there is no mountain so conspicuous above its neighbours as to attract notice, even as far as the Spey. Nor in any other situations would the comparatively moderate eminences of Bel Rinnes, of the Buck of the Cabrach, and of Bennachie to the eastward of this river, be distinguished, though attaining an average height of about 2000 feet; but surrounded by still lower elevations, they become conspicuous for want of competition.

If there is nothing to distinguish the mountains of Cantyre, Knapdale, and Lorn, from each other, neither is there any hill of much conspicuity in Morven, though forming one rude tract of lofty land. Those of Ben chun and Ben y attan are the most remarkable; partly from their insulation, and partly from the very singular geological fact of their bearing on their summits insulated portions of coal strata. In Ardgower and Airdnamurchan, Scuir Donald may compete in altitude with Ben Lomond.

If we now take a tract bounded by Loch Arkeg and Loch Morrer to the north, and by the Great Glen eastward, the whole may be considered a group of mountains without any intervening valleys; the whole of which are rude, yet little distinguishable, while they attain an average altitude ranging from 2000 to 3000 feet. Hence, indeed, as far north as Loch Broom, every thing is mountain, and all the mountains are lofty; while no where is there any valley more than the ordinary glen which conducts a stream, if we except the seats of the few lakes interspersed throughout this wild district. This whole portion is among the most impracticable parts of Scotland. It cannot be traversed except in east and west directions, and by following the courses of the streams; while, in consequence of the universal sheep farming, it is nearly uninhabited; the very few shepherds' houses and petty farms which exist being nearly invisible, and the mass of its population being confined to the shores of the sea and of the firths.

The mountains of Loch Nevish and Loch Hourn are the first which begin on this coast to attract notice, and they are scarcely exceeded in grandeur of appearance and altitude by any of our hills, while, in rudeness and rockiness, they yield to none. Among these wild and crowded summits, the most marked are Drumdeuchary, Ben Line, Ben Scrian, and Drumfalla; but, with the exception of the two valleys of Glen Elg, the whole tract, as far eastward as Loch Lochy and Loch Ness, is often almost the rival of the loftier western mountains. The extremity of Loch Duich is similarly distinguished by the lofty and rocky Ben Attow, rising, like the preceding mountains, to an altitude of nearly 4000 feet.

It is not necessary to particularise any other mountain till we arrive at Loch Maree in this direction; and a large proportion here, both of the sea coast and the interior country, is of a tamer character than the preceding, with much less elevation. This is peculiarly true of the district of Applecross, and generally of the sea coast as far as the Ru Rea, a tract of red sandstone. To the north of Loch Maree, however, the mountains become again conspicuous; and of these Ben Lair overtops all the surrounding country, attaining an elevation little short of 4000 feet, and accompanied by Sleugach and others not very far inferior. Hence a continued mass of rocky and lofty mountains, broken into fearful precipices, and separated by deep narrow glens and ravines, extends to little Loch Broom, terminating there in the highly distinguished Kea Cloch.

This is the highest mountain of the western coast, and it may compete even with Ben Nevis, terminating in serrated peaks resembling those of granite, but formed of the same sandstone. Though rising immediately out of the sea on both sides, it bears all the year round a mass of snow as large as that which remains on Ben Nevis or on the hills of the Dee; a sufficient proof of its hitherto neglected height. If we proceed eastward from this point, the same endless mountains are repeated, but without any elevations peculiarly requiring mention, till we arrive at Ben Wyvis, where the mountain land begins to terminate.

At Loch Broom, the character of the country begins to change, and the mountains, which were formerly grouped and crowded on each other, are shortly found separated by wide intervals, and scattered independently on the surface of a high rocky uneven land, attaining an average elevation of 1000 feet. These mountains also are formed of sandstone, or of that substance and quartz rock; and the most striking of them are Ben More, forming a long ridge, Coul Beg, and Coul More, Suil Veinn, Canasp, and Coy Craig, after which the coast line at last becomes comparatively low, and little characterized by distinct hills, even to Cape Wrath. Suil Veinn, in particular, is noted for its singular form; resembling a sugar loaf when seen on its extremity, and, laterally, presenting a ridge which is precipitous on all sides, and extremely difficult of access. Rising to the height of 1000 feet from the irregular table land of 1500, on which it suddenly starts up, it forms a conspicuous object to vessels navigating this coast.

Interiorly, the loftiest elevation of this part of the country is Ben More Assynt, connected with the ridge which confines Loch Shin, and with the group of mountains at its head, among which the Stack is remarkable for its pure conical form. The singular and naked ridge of Balloch nan fey is the last remarkable mountain on the western shore, formed of bright quartz, which Mr. Pennant mistook for marble, and shining in the sun as if it were covered with snow.

The northern parts of Sutherland constitute, with little exception, an irregular hilly moorland, rather than a mountainous tract; and the only conspicuous mountains are Ben Ay, Ben Klibrigg, Ben Laighal, and Ben Hope, separated widely as under and thence the more conspicuous. These hills attain an average elevation of 3000 feet above the sea, and one of 2000 above the general level of the moorland from which they rise. On the east side of Sutherland, the ridge which terminates at the Ord of Caithness, separating the two counties, is conspicuous for want of rivals, as are those which accompany the Brora and the Helmsdale rivers; but it is unnecessary to name the other elevations of no great note which remain here, or southward as far as the Murray Frith. Meal Fourvony, rendered as formidable in Arrowsmith's map as Ben Nevis itself, is a mere summit of no great height rising above the general ridge. On this particular subject we shall only further remark, that no truth whatever exists in that map as far as relates to the characters of the ground, or to the general and comparative sizes of the mountains. Many of the loftiest and best marked mountains are utterly unnoticed, while others of no note are represented as emulating the most noted and most elevated. If the apparent directions of ridges on it deserve only neglect, so do the characters and represented altitudes of the mountains.

If from the Highlands we now turn to the southward, there are but few hills which will be found to deserve the name of mountains, and few elevations sufficiently conspicuous above the rest to merit any notice.

In the middle district, the Sidlaw and the Ochils are the most conspicuous, as well for their altitude as their continuity; but there is in these no elevation remarkably towering above the rest. The Lomond hills in Fife, Arthur's Seat near Edinburgh, and North Berwick Law, produce a greater effect to the eye than most of the mountainous elevations of the south, from their unattended rise. Thus also the ridge of the Pentland, though not exceeding 1500 feet, is more conspicuous than the far higher hills which but barely overtop the general mountain land to the southward.

Among these, Tinto, to the west, is distinguished, as is Lother hill, Queensberry hill, Wardlaw, Whisp hill, Ruber's Law, and the conspicuous triple summit of the Eildon hills, which forms such a beautiful object throughout the whole of Roxburghshire. Criffel forms a mountain singularly remarkable for its insulation, though not lofty; and southwards, the granite ridges of Cairn's Muir complete the only enumeration of these mountains which it is necessary to give.

Rivers of Scotland.

Rivers of Scotland.

We shall here enumerate the most important of these, without making a distinction between the Lowland and Highland streams, as it is a distinction that would not be easily maintained.

Tay.

Of these, the first in importance is the Tay, the chief of the rivers of Britain, since it has been ascertained by Mr. Smeaton to carry more water to the sea than even the Thames.*

Spey.

The course of the Spey is much more simple and decided than that of the Tay; receiving no rival, though many small tributaries, and continuing one decided river from its fountain head to the sea at Speymouth. That head is a small lake, scarcely deserving of the name; rising at the head of Glen Roy, and fed by the drainage of the surrounding wet land. Flowing on, it receives no stream of any note, till it meets the waters of the Truim at Invernahavan, of the Calder at the bridge of Spey, and of the Trommy descending from the hills of Gaich; nor is it necessary to name the various inconspicuous rivers which join it at a hundred points till it unites with the more important Avon. Neither from this junction does it receive any other stream worthy of distinction; being fed by innumerable rivers and brooks through its whole course, till it rolls its broad waters into the sea.

Dee.

The course of the Dee, like that of the Spey, is simple, as it receives no river of note, being fed by the various streams which descend on each hand from the mountainous and hilly countries through which it holds its course. But, at its commencement, the Geonly has an equal claim to continue its name, as both rivers are at least of equal magnitude where they join. The source of the Dee branch is at the foot of Cairn Gorm, and the termination of this great river is at Aberdeen. Like the Spey, it is subject to great irregularities in the state of its waters, and through the largest part of its course is a violent and rapid river. This uncertainty, both in the Spey and the Dee, is the consequence of their simplicity of origin and supply. Hence a rainy or a dry season or period produces its full effect; while the Tay, receiving its supplies from remote and discordant places, is maintained in a more general state of average by the compensations thus caused.

The sources of the Don are also those of the Devron; the former river meeting the sea together with the Dee, and the latter running to the north to discharge itself at Banff. The chief addition which the Don receives is from the Urie; but the Devron is swelled by a great many waters of considerable size, too little noted, however, to require a detailed enume-

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* See our article PERTHSHIRE, Vol. XVI. p. 423, for a full account of this river, and of the picturesque scenery through which it flows; and our article on PHYSICAL GEOGRAPHY, Vol. XVI. p. *520.

Statistics. Geography, physical.

ration. Of the other rivers of Aberdeenshire, the Ythan, discharging itself near Slains, and the Ugie near Peterhead, are the only ones that require notice.

The Findhorn must be named among our principal rivers. This holds a course parallel to that of the Spey, indicating, together with that of the Nairn, the directions of the hills and their correspondence to the stratification of the rocks, more accurately and extensively than any other portion of Scotland except the Glenmore na Albin, to which they are parallel. The Findhorn rises among the wild but tame mountains of Monagh lea, and without combining with any other river of note, holds its own course to the sea near Forres, fed by the small streams which descend from each side of the great valley by which it is conducted. The Nairn has two distinct sources, one in the singular and elevated lake Duntelchak and the other in the neighbouring hills, nor does it receive any river till it falls into the sea at Nairn.

Compared with its magnitude, the Ness is among the shortest rivers in Scotland, meeting the sea at Inverness very soon after quitting its parent lake, of which the Oich and the Tarff at the upper extremity, with the waters of Glen Morison, Glen Urquhart and Foyers, are the principal feeders. The Conan, running into the Cromarty Firth, and the Glas into that of Beauley, can only be classed among our rivers of an inferior rate.

Among the northern rivers, the Oikel is one of the most important, having its origin near the western sea, in the vicinity of Loch Broom, and terminating in the Firth of Tain, where it joins the Carron. The Shin, discharging the waters of Loch Shin, is the other of its principal feeders. To pass over the smaller rivers of Sutherland, the two eastern flowing ones alone worth notice are the Brora and the Helmsdale; both aiding to unwater the interior of this wild country. Of the northern flowing, the most important are the waters of the Hallodale, the Strathy, and the Naver, having their rise in the same hills as the preceding two, and serving to indicate the highest level of this country. In Caithness, the rivers of Thurso, of Forse, and of Wick, are almost the only ones deserving enumeration. The water of Farr, further west in Sutherland, may rank with the Hallodale and the Strathy; and the Hope discharging Loch Hope, is even shorter than the Ness, since its whole course from the lake does not exceed half a mile.

It must already have appeared that the tendency of all our principal rivers is to the north, the east, and the south; scarcely any one worthy of notice meeting the western sea in the mountainous division of the Highlands. Thus the general elevation and declivity of the country are indicated; and thus it is easy to find the points of the average highest elevation. For all the rivers which have yet been enumerated, these will be found at the sources of the Dee and Tilt, running in contrary directions, of the Spey and Roy similarly dividing, of the Don and the Devron, of the Strathy and the Helmsdale, of the Oikel, and of the waters which feed Loch Hope, Loch Laighal, and Loch Naver.

Of the western flowing waters in the northern Highlands, those of Loch Maree and Loch Carron are the first two that seem to deserve notice, and even these are but inferior streams. Nor is there any one which can be ranked high, in this direction, but the Lochy, discharging the waters of Loch Lochy, together with those of the Roy and the Spean, and thus forming a powerful river flowing into the head of Loch Eil. Further south, the rivers which meet Loch Etive, Loch Awe, and Loch Fyne, together with the exit of Loch Awe itself, are in this division; but they are comparatively insignificant, as are all those which now occur to the very boundary of the Highlands.

Though the Forth has its origin in the Highlands, it shortly becomes a lowland river, and must be considered next in rank to the Tay.*

The Clyde must be allowed the next rank, and it is the great exception to the general courses of the Scotish rivers. Its various sources are traced in the hills about Elvanfoot, whence, after a northern course, it turns to the northwest, and pursuing its tortuous and intricate journey, joins the salt water below Glasgow, without having received any river of importance throughout the whole space.†

The course of the Tweed is even more intricate, while its springs are not far removed from those of the Clyde and the Annan, marking the great central elevation of the southern mountain land.‡ Passing Peebles, it is already a large river, and while fed by endless and nameless waters, it also receives the long celebrated rivers, the Ettrick, the Yarrow, the Gala, and the Tiviot, becoming a wide stream, as it reaches the sea at Berwick.§

The Annan is among the chief of the southern flowing rivers, having rivals only in the Esk, the Dee, and the Nith. The springs of the Esk correspond nearly with those of the Ettrick; and thus again we trace the highest elevations. Thus also the sources of the Nith interfere with those of the Clyde and the Ayr, as at one point they also approach to the springs of the Tweed. In the same way the remote heads of the southern Dee must be sought with those of the Doon flowing to the northwest, while this river becomes naturally increased by its junction with the powerful Ken, forming a large river where it meets the sea at Kirkcudbright. The Fleet and the Cree are secondary rivers, and the others which belong to this part of Scotland require no enumeration.

Lakes of Scotland.

We shall enumerate these in the order of their importance and connexion, rather than in a geographical one, which could not be accurately followed.

Loch Awe, an immense body of water, is marked by the singularity of its exit. The total length of this lake is about 22 miles; and with a prevailing breadth of one mile, it becomes about two or more wide near its northern extremity, which forms its exit as well as its apparent entrance. Here some small islands diversify its surface, and here also it produces some very grand and striking scenery; but the lower part is generally tame and uninteresting, though containing a group of islands near the middle. It is partly fed by Loch Avich, a mountain lake of no note.

Loch Lomond, already described under Dumbartonshire, Vol. VIII. p. 196.

Loch Tay, Loch Dochart, Loch Earn, Loch Voil, Loch Chon, Loch Ard, described in Perthshire, Vol. XVI. p. 422.

Loch Cateran, Loch Achray, Loch Venachar,

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* See Forth, Vol. IX. p. 482; and Perthshire, Vol. XVI. p. 424.

† See Lanarkshire, Vol. XII. p 512.

‡ See Peebles-shire, Vol. XVI. p. 347.

§ See Roxburghshire in this volume, p. *474.

LOCH LUBENAIG, described in PERTHSHIRE, Vol. XVI. p. 423.

LOCH RANNOCH, LOCH TUMMEL, LOCH DHU, LOCH BAA, LOCH LYDOCH, LOCH OF MONTEITH, LOCHS OF THE LOWES, LOCH CLUNIE, LOCH MARLY, described in PERTHSHIRE, Vol. XVI. p. 423.

LOCH ERICHT, LOCH GARRY, described in PERTHSHIRE, Vol. XVI. p. 423.

LOCH NESS, and the other lakes of the Great Glen of Scotland, have been fully described in our article INVERNESS-SHIRE, Vol. XII. p. 185; and in our article NAVIGATION INLAND, Vol. XV. p. 266.

Loch Maree, a magnificent lake is about twelve miles long, and above three wide in the middle, reaching the sea at Pol Ewe after a course of about three miles. In the middle it contains a labyrinth of wooded islands, which add much to its beauty; while, from the ruggedness and loftiness of the including hills, it presents much picturesque scenery, with considerable grandeur of character. Lying in a country of difficult access, it is however scarcely known, though meriting the attention of the traveller.

The western lakes of Sutherland are little remarkable either for their size or their beauty; and among them Loch Assynt and Loch More are the chief. But the chain which includes Loch Shin, formerly noticed, is important, at least from its extent. The two westernmost of the three, Loch Merkland and Loch Geam, are small lakes; but the length of Loch Shin is sixteen miles, though its breadth, like that of Loch Tay, is never more than a mile. But it is utterly wanting in beauty, as is true of all the remaining lakes in this country. Of these, the chief are the Laighal, the Naver, and the Hope, the latter of which is about six miles in length.

Of the southern lakes, there is not one which seems to merit enumeration except Loch Leven, already fully described in our article KINROSS-SHIRE, Vol. XII. p. 461. One only remark we shall make in concluding this account of the rivers and the lakes of this country, and it relates to the small value derived from them by the proprietors or the country at large. When that extent, which we have already pointed out, is considered, the large quantity of useless property must be apparent; but this would have been very materially extended if we had added the superficial measurements of the innumerable mountain lakes and pools which it was impossible to include. The salmon fishery of the rivers is an important branch of commerce and wealth; but if we except Loch Leven, there is not even an attempt made to derive any profit from all these lakes, while they are not even fished for the merely domestic consumption of the surrounding population. If we except the slender amusement of sportsmen, there is as little use as profit derived from this immense tract of valuable water. It is certain that, by a proper system of stocking and fishing, a large supply, if not also a large rent, might thus be produced, we should say created, as is done in Europe generally. It is to be seen whether the proprietors will remain, not only blind to their own interests, but uselessly severe in restricting the fishing of that which would increase instead of diminishing under a proper fishery, and which would at least benefit others, by permitting or encouraging the use of what is of no benefit to themselves.

Sea Lochs and Firths.

It is impossible to pass over these without notice, as they form such an important feature in Scotland, and are indeed occasionally with difficulty separated from mere fresh water lakes. We must, however, limit ourselves to a few of the most remarkable.

Among these, the inlets of the western coast of the Highlands are the most numerous and conspicuous, while they are frequently interesting in a commercial view, as excellent harbours, and as the seats of the herring fishery. Commencing from Loch Eribol in the north, we find it forming a magnificent bay and a safe anchorage, capable of holding all the British fleet, being the last harbour of security till we reach Cromarty on the eastern coast. Though Loch Inchard and Loch Laxford are excellent harbours, they are little required; but those two inlets are the seats of a salmon fishery. The great sinuosity of the Kylescuagh to the southward of these, offers also a landlocked harbour that would accommodate fleets were it required.

Loch Broom.

Passing over Loch Enard, as an open bay, we find the immense opening of Loch Broom, a harbour for fleets also, and once the seat of a valuable herring fishery, as it is now that of a limited fishery for cod, and of the stationary town Ullapool. Here was one of the establishments made by the Company for the fisheries, before the true nature and value of this was understood, and while the only object appeared a desire to rival the imaginary great gains of the Dutch in this branch of industry. It was forgotten that Dutch capital was forced into an unproductive direction from its excess, while that of England was fully and better occupied; and it was also not then known, or forgotten, that the resort of the herring was capricious and uncertain. Thus it has proved; since this and all the other similar establishments have been long rendered useless by the change of the resort of this fish, partly to the northward, but chiefly to the eastern coast.

Little Loch Broom is also a secure but an useless harbour; but Loch Greinord is nearly an open bay. Pol Ewe is not only capacious but safe, and is the station of the Stornoway packet, as well as the seat of a valuable salmon fishery. Gairloch, next to it, is an open harbour, but a good one, while it is also the centre of one of the most extensive cod fisheries on this coast,—a fishery that might be much extended, were it not for the want of persevering industry.

While Loch Torridon, like Loch Broom, contains one of these large and now nearly useless establishments, it is also one of the largest and most magnificent inlets in Scotland, its total depth being twelve miles. It is divided into three parts, of which the two interior form spacious basins with narrow entrances, sheltered from every thing, and capable of accommodating large fleets. Loch Carron, including Loch Kishorn, penetrates even deeper into the country; and, though comparatively open, it also offers secure and extensive harbours, while it is the seat of two Highland villages of unusual magnitude. It is interesting, in a physical view, as giving indications of its having once been a fresh water lake, which, by the gradual wearing down of its barrier, has at length admitted the sea.

Loch Alsh, &c.

Loch Alsh, including Loch Duich and Loch Long, is a singularly intricate and spacious inlet, formed conjointly between the island of Sky and the mainland. Its total depth may be taken at twelve miles, and it offers the best anchorages on the western coast; that of the Cailleach stone, celebrated in the history of Haco's great expedition, being the common resort of ships making the inner passage to the north, as is that of the Kylehaken also. Loch Duich in itself forms one of the most engaging scenes on the west coast. Loch Hourn, succeeding to the southward, forms the next deep indentation in the land; and while it also offers spacious and secure harbours, scarcely required where almost every opening is an anchorage, it comprises the grandest series of wild and picturesque scenery which is to be found on the western coast, not yielding indeed to any portion of Scotland. The narrowness of its upper portion, and the precipitous and rocky nature of the mountains, with the wild wood every where dispersed, gives it a character of ornament, superadded to sublimity and rudeness, which is rarely equalled.

If Loch Nevish equals Loch Hourn in space and security as a harbour, it is without beauty; yet, in former days, both these lochs were valuable as the chief resort of the herring, which has long since abandoned them. Hence the principal inducement for a new and excellent road to the former, branching from the Glen More, which is now nearly useless. Loch Morrer, being a fresh water lake, ought to have been enumerated with the lakes; but it is separated from the sea by so very minute an interval, that it seems almost to take its rank here. The joint inlet of Lochananougal and Loch Aylort is spacious, but does not form a good or useful harbour. It derives some consideration, however, from its being the seat of the nearly useless ferry from Arasaik to Sky, and from the excellent new road by which it communicates with Fort William. Loch Moidart, however spacious and deep, is rendered useless from its intricacy, and from the difficulty of getting out to sea in westerly winds.

Loch Sunart.

Of the western inlets, Loch Sunart is among the deepest, since its length from the entrance to the extremity exceeds twenty miles. As a harbour it is endless, yet unnecessary; being superseded by that of Tobermory in Mull. Its almost sole use is to form a water communication with Strontian; but its margin, which is often very striking and picturesque, presents an interesting circumstance in the remains of the ancient Caledonian forest, consisting of oaks not yet dead, and probably not less than 1000 years old, the trunks of which measure from twenty to twenty-five feet in circumference.

The Linnhe Loch.

The Linnhe Loch is, if not the largest, the most important inlet on the western shore of the Highlands; and if we include Loch Eil, it even rivals Loch Fyne in length. The total length from the point of Morven to Fort William is thirty-two miles, and that of the western branch of Loch Eil is about nine. It is properly the continuation of the Glen More; nor is it difficult to imagine that it once penetrated deeper, possibly even to the Murray Frith, and that the solid portion of this great valley has been chiefly produced by the accumulation of alluvial matters. Its importance, as giving access to a large coast, as well as by leading to the Caledonian canal, is manifest; and is rendered evident to observation by the number of coasting vessels by which it is perpetually navigated.

Thus also it is the entrance to Loch Leven and to Loch Creran. By means of the former there is access to the extensive slate quarries of Glenco; and thus also it would be easy to establish a communication between the eastern and western seas, by means of a road which nature has hitherto in vain pointed out. From the king's house at the head of Glenco, there is a nearly level surface of sixteen miles to the head of Loch Rannoch, affording the greatest facility for a road; while the navigation of that lake might, if required, supersede the road hence to Blair, and thus through Glen Tilt as far as the Tarff. A further piece of nine or ten miles would fall into the road already made to the westward of Braemar, and thus the communication with Aberdeen is completed. When so many difficult, and some superfluous communications have been made, it is rather surprising that this cheap and obvious one should have been overlooked. The interesting scenery of Loch Leven is generally known, as is that of Loch Creran, but the latter is useless in every sense.

The length of Loch Etive is twenty miles; the upper half having the characters of a fresh water lake, and the lower being navigated as far as the iron works of Bunawe. The higher portion is not very salt, and often quite fresh; and here also are the perishing remains of an ancient oak forest, similar to that of Loch Sunart. These two, we believe, are the only remains yet living of the ancient oak forests of Scotland; though there can be no doubt that the greater number of the present coppices are, like these, the progeny of the ancient Sylva Caledonia. The trees of Loch Etive are of similar dimensions to those of Loch Sunart, and though only pollards, are flourishing at the branches which shoot from their knotted and hollow trunks. The whole is a scene of great wildness and grandeur, but without variety. Below Bunawe, the strait of the Connel is noted for the turbulence and fall of the tides at ebb and flow, as it also is for the celebrated ruins of Dunstaffnage castle.

We may pass over Loch Feochan and Loch Melfort, as of no peculiar interest, to notice Loch Craignish, rivalling Loch Lomond in the beauty of its islands, and the picturesque effects of its singular scenery. Here also the shallower indentation of Loch Crinan forms the western avenue to the canal of that name, communicating with Loch Fyne, and cutting off the long navigation round the Mull of Cantyre. Loch Swin, which is ten miles deep, is a narrow and parallel inlet, remarkable chiefly for the extremely singular and beautiful scenery of its upper extremity; and Loch Killisport, parallel to it, but of less depth, is a good harbour, without being a necessary or useful one.

By means of Loch Tarbet, nearly meeting Loch Fyne, the peninsula of Cantyre is rendered almost an island; and here a communication between the two is practicable by the expedient of carting the boats across the narrow isthmus which separates the east and west Loch Tarbets. Hence was invented the fictitious tale respecting Magnus Barefoot and Donald Bane; a tale which betrays itself, when it is recollected that Magnus was the proprietor of all the islands already, and that Donald was a refugee and a supplicant, and had never been the possessor of the lands which he is asserted to have thus ceded. As an anchorage, Loch Tarbet is not used, but it is the station of the packet for Isla.

Passing now the Mull of Cantyre, we arrive at the excellent harbour of Campbelltown, a small but an important inlet from its position, as well as for its commercial uses. Beyond this we enter Loch Fyne, the largest indentation which Scotland possesses. The total length of this great sinuosity is forty miles, and, as far as Loch Gilp, it is four miles in breadth. Having been the most steady resort of the herring, it is a most important fishing station, while it also forms an extensive water communication for a large tract of the western Highlands, peculiarly valuable as connected with Glasgow and the low country. It offers little picturesque beauty to the mere traveller. Loch Straven and Loch Ridan, branching from the Kyles of Bute, are nearly uninteresting in every sense.

The length of Loch Long is sixteen miles, and together with Loch Goyl, it forms an extensive indentation, while it also affords a ready avenue to Loch Lomond. Hence it is now well known, nor need we do more than barely mention the neighbouring opening of the Gare Loch. The æstuary of the Clyde itself may however be looked on as a similar sea loch to Loch Fyne, and its total depth from the Garroch head is about thirty-two miles.

The western coast presents but one more inlet, in Loch Ryan; and, in the Solway firth, it is sufficient to mention the wide bay of Luce, that of Wigton, and the much smaller barbour of Kirkcudbright.

On the eastern coast, we find comparatively few indentations, a misfortune which is even more severely felt by England, in the want of harbours on those shores where commerce and industry have found their most tempting seats. There is scarcely indeed more than one good harbour on the whole eastern side of Scotland; all except Cromarty being bad and unsheltered roadsteads, or shallow and inconvenient firths and tide rivers.

The great sinuosity of the Forth is the first in order as in magnitude, and has already been fully described in our article Forth, Vol. IX. p. 482.

The length of the firth of the Tay, from Button Ness to Perth, is scarcely more than half that of the Forth, not exceeding twenty-six miles, while it has the character of an inland sea throughout. Though not very open to the sea, it is a bad harbour, from its want of water, but still more from the difficulty of an entrance encumbered and obstructed by banks and shifting shoals. It is, however, the medium of a considerable commerce; while, in splendour and wealth, and in picturesque beauty, its banks even exceed those of the firth of Forth. Nor does it shoal so rapidly above. At present, the ebb is such in the upper parts of this last inlet, as to leave an enormous extent of mud dry at low water, and every year the salt marshes gain on it, so as to indicate the day when it will become, far below Alloa, what it is now near Stirling, a tortuous river, creeping through flat meadows. It is more probable that the greater obstructions to the firth of Tay will be extended near its entrance, where the most rapid accumulation of alluvium is taking place, and thus, at some future period, it may become an inland sea, of a far different character; while, above, the rich lands of the Carse of Gowrie are extending, by the lateral addition which the process of projecting embankments produces.

Were the basin of Montrose what it appears to be in the map, it would be one of the most enviable harbours in the world; but it possesses no water, and is absolutely useless. Hence, also, even to the Murray Firth, there is not an indentation that requires to be named; and even this is a deceptive spot to those who might be tempted to judge of it from the general aspect, both of itself and of the surrounding land. The total depth of this great sinuosity is seventeen miles, of which seven belong to the Firth of Beauley. In picturesque beauty it cannot well be exceeded, whether we regard the mountain outline, or the richness and cultivation of its shores. But the navigation is singularly difficult and dangerous; and it is thus a most unfortunate entrance to the Caledonian canal. So shallow is the water, that even the smaller class of vessels can only pass it with an expert pilot; as the navigable depth is limited to the wandering river, whose blind course, between banks of mud and sand, is concealed by the water, which never ebbs from these shallows. Nor is the anchorage at Inverness much better; being deficient in depth, though secure from sea and wind.

Firth of Cromarty. If it were a compensation to the defects already enumerated, of the eastern shore of Scotland, the harbour of Cromarty might atone for any thing. This magnificent and truly inland sea is twenty miles in length, and at one point seven in breadth; while, with respect to beauty, whether of its mountain outline and boundary, or of cultivation and richness of aspect, it exceeds all the others with which it might be put into competition. As a mere harbour, it is capable of holding the fleets of Britain, though shallow and useless in its remoter parts; and as a harbour, also, it is not only easy of access, but rendered so obvious by the height of its entrance through the lofty and corresponding Suters, that it may be taken without a pilot in the darkest night, and in the worst weather. Were it possible that commerce and capital should ever find their way to Cromarty, it might even supersede every rival port on the eastern coast of Britain.

Firth of Dornoch. The Firth of Dornoch, or Tain, is about twelve miles long, and its course is both intricate and contracted at the middle. It is also shallow in its upper part, where it might otherwise form a safe harbour, were any harbour required in the vicinity of Cromarty. The Fleet is the last of these sinuosities. But this is little more than a contest between shoals and marshes; and as it has now been dammed by a mound with a sluice, which forms a road superseding a former ferry, it will, in no long time become a series of meadows and marshes, to be ultimately consolidated into a valuable tract of land.

For an account of the islands of Scotland, we must refer to the following articles, under which they have been described with great minuteness.

1. Ailsa, Vol. I. p. 306.
2. Arran, Vol. II. p. 493.
3. Barra, Vol. III. p. 402.
4. Benbicula. Vol. III. p. 447.
5. Bernera, Vol. III. p. 478.
6. Bute, Vol. V. p. 152.
7. Iona, Vol. XII. p. 216.
8. Isla, Vol. XII. p. 318.
9. Jura, Vol. XII. p. 400.
10. Kilda, St. Vol. XII. p. 450.
11. Lewis and Harris, Vol. XII. p. 615.
12. Mull, Vol. XIV. p. 739.
13. Orkney Islands, Vol. XVI. p. 1.
14. Rona, Vol. XVII. p. 444.
15. Ronay, Vol. XVII. p. 444.
16. Rum, Egg and Muck, and Canna, Vol. XVII. p. *480.
17. Sanda, vol. XVII.
18. Scalpa, Vol. XVII.
19. Scarba, Vol. XVII.
20. Shetland Islands, Vol. XVII.
21. Shiant Isles, Vol. XVIII.
22. Sky, Vol. XVIII.
23. Staffa, Vol. XVIII.
24. Tirey and Coll, Vol. XVIII.
25. Uist, Vol. XVIII.

CHAP. II.

Natural History, Geology, Mineralogy.

Geology.

In that which is commonly called natural history, including the departments of zoology, in all its branches, and botany, there is little or nothing, in its nature in Scotland, so far differing from that of the rest of Britain as to require a separate detail; and we shall here therefore refer to our article on England, where that subject has been already generally treated. It is in the branch of geology and mineralogy alone that the distinction is real and important; and therefore we shall here occupy the space which we have to bestow on this subject, with a sketch of the geology and mineralogy of Scotland: an extensive subject, which might well occupy a volume.

Primary rocks.

The account already given of the physical geography may be considered as the basis of this subject, and therefore we have already cut short a large portion of this article in that particular one to which we may now refer. It only remains to describe the general places and connections of the several rocks which are found; and, we believe, that the best method will be to enumerate them according to their geological places and esteemed order of superposition. We shall, therefore, commence with granite, and proceed upwards to the superficial strata. We must also premise, that as the subject of coal has already been amply treated in our article on that subject, we shall here omit that important branch of the present enquiry.

Granite.

Granite is found in distinct and distant parts of Scotland; but the most extensive tract is in Aberdeenshire. Here it forms the great mountain mass of Cairngorm, Ben Avon, and the associated mountains on both sides of the Dee; ramifying also into Inverness-shire and Perthshire. Over some considerable tracts it is continuous; but in others it is interrupted in that respect by patches more or less extensive, of the schistose rocks which are superincumbent on the mass. When it vanishes, it is accompanied by veins penetrating the adjoining rocks; and of these, the examples in Glen Tilt are celebrated in the history of Scottish geology, as having attracted the attention of many of its geologists. The arguments and views drawn from these are well known to the cultivators of this science; and being foreign to a sketch of local or topographic geology, we shall pass them over.

From this great centre, the granite is found extending through all the lower parts of Aberdeenshire, even to Peterhead, and further north, till it is cut off by the superincumbent slate, and other rocks which follow it in this direction. To the south of Banff it reappears in another considerable tract, and is there cut off again and terminated by the western mountains of this county. It would be impossible to detail the boundaries of the granite in Aberdeenshire, and the relative spaces occupied by the other rocks intermixed with it, for want of sufficient political or local boundaries and names; but it may be safely estimated, that one half the country eastward consists of this rock, irregularly intermixed with the gneiss, slate, and other substances which lie over it. Here also we must remark, that it occupies the lowest levels as well as the loftiest mountains, being found even on the sea shore, at Peterhead, and elsewhere.

In the neighbourhood of Aberdeen it is extensively quarried both for home consumption and exportation; and it is properly esteemed to be one of the most valuable kinds in the market for its beauty and durability. That it was not used for Waterloo bridge instead of the far less durable Cornish stone, has been a frequent cause of regret.

Proceeding northward, the next tract of granite lies on the east coast of Sutherland, occupying a space of about eighteen miles on the shore, or near it, and reaching into the interior country to a point indefinable for want of proper marks and references. This tract is entirely hilly, though not high, and is tolerably uninterrupted as far as it extends, though re-appearing again in the interior in a few insulated outstanding patches. It is nowhere wrought.

The next granite to the north must be sought in the Orkney and Shetland islands, where it is very scattered, and seldom of any great extent. In Orkney in particular, the appearances are extremely minute, being confined to a small spot near Stromness, and another at no great distance from it in one of the neighbouring islands. In the Shetland islands, Foula presents an equally insignificant patch on its eastern shore; but on the main islands the appearances are more extensive. Here it chiefly occupies the western side of the Mainland, reaching in an interrupted manner, or in two distinct regions, from the north to the south of its widest portion. Ronas Hill, the principal eminence, is formed of granite. The other appearances are so scattered, as to be nearly undefinable in words; but we are less anxious to detail the exact geology of the Shetland islands, as we can refer to a very accurate and detailed paper drawn up by Dr. Hibbert in the *Edinburgh Philosophical Journal*, and accompanied by a map, as well as to his more extensive and complete work on those islands.

In the western Highlands, on the mainland, the appearances of granite are so scanty and scattered, that we are unable to point out the unmarked and unknown places where they exist, and shall here therefore name only one mass in Kintail, near Loch Duich, because we can refer to a mark for it. In the islands of the same coast, the only mass of this rock is that which forms the Ross, or western promontory of Mull, already noticed for its commercial facilities; a mass which extends also to a little island at some distance from the shore. The granite which was formerly noticed as found in Harris, is only a vein. On this shore, however, we ought also to indicate a small tract which lies in the neighbourhood of Strontian.

This brings us to Fort William, whence we may return eastward through Perthshire. The granite of Fort William forms the base of Ben Nevis; and, after some interruption, it reappears in the moor of Rannoch, and again in Cruachan and the surrounding mountains, which forms another of its most considerable appearances in Scotland. From the moor of Rannoch, it appears at various places, till, in a certain sense, it may be conceived to join with the great mass of Aberdeenshire, though the exact points of appearance, and the limits, are not defineable without a geological map.

Excepting a small portion near Comrie, Arran presents the only remaining granite to the northward, forming its well known group of mountains; but as we have already referred to Dr. Hibbert's accurate work for the Shetland islands, so we shall here refer for all the nicer details of Arran to that of Dr. Headrick, a similar pattern of minute accuracy, as for the correcter details of the islands in general, we must refer to Dr. MacCulloch's general work on these, comprising matters far too extensive for our present narrow space.

The remaining granite of Scotland must be sought in Galloway, in Criffel, and in the mountains which range from the Fleet along the ridge of Cairns-muir.

The next rock in geological order is gneiss, and this forms the most extensive of the rocks in the northern division of Scotland. To define it by words would be a hopeless task. In Aberdeenshire, it occupies a large portion of that space which is not granite; being, in a superficial view, irregularly intermixed with it. On the north of Scotland, if we commence near Reay in Sutherland, it may be considered to predominate on a line nearly due south nearly as far as Killicrankie; while, westward, it occupies the whole country, with the exception of the granite already mentioned, of some porphyry, and of some considerable tracts of quartz rock and red sandstone. The future remarks on these will give a better positive idea of the extent of the gneiss, in the way of exception, than if we had here attempted to define its most irregular boundaries.

It is not found, as far as we yet know, to the south of the Highlands, or southward of the Clyde and Tay; but it forms a considerable portion of Shetland. The island of Yell is nearly all composed of it, and it occupies also a conspicuous part of the Mainland. In Foula and Orkney it forms little patches accompanying the granite. In the Western islands, almost the whole of the long island consists of gneiss, as do Coll, Tirey, and Iona; as well as Rona, and a certain portion of the south-east part of Sky, and a small part of Mull, connected with the granite of that island.

The characters of this rock present endless variety in Scotland, but it is nowhere used for building. A few of the most fissile kinds are indeed sometimes employed for roofing, in the windy districts, being well calculated by their weight, for this office. We already remarked, in the account of the Physical Geography, that the general bearing of the stratification was north-eastward; and shall only further add, that though the prevailing dips are southerly, they are often reversed, while the angle of inclination is also very irregular.

The next rock in order is mica slate; and the boundaries of this are somewhat more simple, at least as to the larger mass, though there are many inferior portions of which it would be impossible to convey an accurate idea.

This greater tract may be considered as commencing at the Mull of Cantyre, extending northwards, with exceptions from other intervening rocks, as far as Cruachan, and then stretching across the island so as to be bounded southwards by the declivities of the mountains; while at the northward line, its intermixture and alternations with other rocks are so numerous and variable, that it does not admit of definition. We can only remark, that it is gradually extenuated as it proceeds towards the east, and that it at length disappears.

Independently of this great mass, mica slate occurs dispersedly in various other places. It is interstratified with the gneiss on various occasions, and very particularly when they meet in Perthshire. On the west coast, it occurs similarly among the beds of the same rock; as it does in Arran near the granite, and in Banff and Aberdeenshires, both with the granite and the gneiss.

In the islands, it exists, but is little conspicuous. In Shetland, it is found with the gneiss in various places, and it occurs partially in Sutherland, Caithness, and Ross, both to the eastward and westward; these latter connections being similar to what it possesses in some of the northern islands. In the southern islands, it is most remarkable in Jura and Scarba; though scanty in both, from its mode of interstratification with quartz rock and clay slate. In Bute, it is conspicuous; but this island is so much a part of the adjoining land, that we scarcely think it worth while to consider it separately.

In the south of Scotland this rock is rare; but it occurs occasionally on the confines of the granite, though never forming a separate and noticeable tract, as far as this country has yet been investigated. Mica slate is of no use; but a soft variety, which is properly the talc slate of geologists, has been used in building the two magnificent houses of Inverary and Taymouth.

Quartz rock.

Quartz rock is the next in general order, and it forms a somewhat conspicuous substance in Scotland, though far inferior to mica slate in the extent which it covers. It is at the same time so scattered that we must pass suddenly from one part of the country to another totally unconnected, in attempting to indicate its places.

In Shetland it is found on the western shore, occupying a space which, there, must be esteemed considerable. In the Western islands, there is a considerable tract of it in Sky; but the chief mass lies in Jura and the remainder of that chain, of which it forms a conspicuous portion. The far larger part of Lunga, Scarba, and Jura, consist of quartz rock; and the Paps are entirely formed of it. In Isla also it constitutes the much larger portion of the mountainous district.

On the mainland, it is very conspicuous and abundant in Sutherland to the westward, and is found dispersedly along the coast of Ross-shire; while in the interior country it also forms many mountain summits, occurring without names and incapable of reference. We already noticed in the geography, the conspicuous ridge of Balloch-nan-fey, and may add that it appears in Canasp and many other hills, as also at the eastern extremities of Loch Torridon, Loch Broom, Loch Maree, and other places in this quarter. On the east of Sutherland it is also found in the mountains of Mohr-ben and Scuir-ben. In Banff, it is equally remarkable in the Knock-hill and in many other summits: as, further south, it forms the summits of Ben-y-gloe and other mountains in this neighbourhood, extending in a line westward, far into Breadalbane. We formerly remarked that it had been applied to no uses, and we cannot discover that it is known to the south of the Tay and Clyde.

Clay slate.

The next rock, clay slate, is more important from its commercial value, on which we already made some remarks in treating of the commerce and manufactures of the western districts. It is wrought, besides, in many places in the centre of Scotland; as at Callander and near it, near Loch Lomond, Comrie, Dunkeld, Blairgowrie, and elsewhere, as well as in some parts of the south of Scotland.

The geography of this rock is very extensive and very scattered, so as to render it impossible to follow the whole of its localities without a very lengthened detail, and the aid of a coloured map. And we must also here premise that the geological term, clay slate, does not always imply roofing slate, though this material would unquestionably be found in many places where it has never yet been sought.

It abounds in the southern promontory of Shetland, and is also found scattered in many places to the northward, and in many of the smaller islands. The greatest tract here is that which reaches from Sumburgh-head northwards to Scalloway and beyond it. For the others we shall refer to the accurate documents already pointed out. In the Western islands there is a slender tract of this rock on the eastern shore of North Uist, and the adjoining spots; but the only conspicuous tract is that which accompanies the quartz rock already described, of Jura, and the remainder of that chain. This was formerly noticed in a commercial view. The principal mass occupies the small islands there described, with all those smaller ones which lie in the strait that separates these from the chain of Jura. On this side it skirts the eastern shore, even to the extremity of Isla, where it might also be wrought; and it moreover appears on the western side of the latter island, in various and extensive strata.

In Arran it accompanies the granite; and in Bute and Inch Marnoch, where it is also wrought, it must be conceived to belong to that extensive range which traverses Scotland; and which we may now describe, as it is impossible to pursue any useful order in this description. This tract is of various breadth, but seldom exceeds a mile or two; and it extends in a tolerably straight line to the east shore, passing through the points formerly indicated as quarries. This is not, however, an entire mass of clay slate, but consists of various schistose rocks, among which that substance seldom occupies more than a third or fourth part. The whole belt is defined with tolerable accuracy on both sides; though, without a coloured map, we could not lay down, nor even approximate to its limits. It remains for those to whom its course and extent are thus pointed out, to render it of far more value than it has yet been, by opening quarries in many other places, where a populous and adjoining country would insure a regular and sufficient demand.

On the west shore there is a small portion of clay slate near the Crinan canal, which, geologically, possesses a certain connection with that of the slate islands of this coast, and which might be wrought were there any demand; but we need not point out any more of these trifling strata till we reach that at Balahulish. The extent of this rock is, in this vicinity, more considerable than is apprehended, but as the convenience of the Glenco quarries supersedes any other, it is not likely to be ever more widely wrought.

The very small quantity of slate which occurs occasionally on the western shore, as near Loch Carron and elsewhere, commonly interstratified with gneiss, renders it of no value; and, as a piece of geological topography, it is impossible to define them: but among these we must notice one small portion in Loch Eribol, which might probably be turned to the advantage, at least of the surrounding country, where the poor cottagers are often much troubled to find the means of covering their houses. On the eastern side of Sutherland there is also some slate, near the quartz rock; but no attempts have been made to work it.

Passing the Moray Firth, on this side, we find various beds of slate traversing the country to the south of Cullen and Banff; and some well-known portions of this appear at Portsoy, though no attempts have been made to work it. The topography of these scattered portions is here inexplicable, but we soon arrive at a much more extensive mass, which stretches eastward from Banff, and penetrates a long way south into the interior country. This is a tract already worked, and which might be wrought much more extensively in this rich and populous county, were its existence through so large a space suspected. It is now quarried in Fouldan Hill, possibly elsewhere, and its produce is of a very good quality. To geological science abstractedly, some of its connections are interesting; but the details would take us out of the rigid path of the present topographical sketch of Scottish geology.

To omit noticing a few patches and minuter strata of this rock so scattered and so trifling as to be impracticable in detail, we must now pass suddenly from the north to that immense tract of the same rock which may almost be said to form the south of Scotland. Here again we are lost in attempts to define its boundaries; and, as formerly, must trust partly to the account we shall have to give of the sandstone, which forms the chief exception.

But of this rock, we must first remark, geologically, that its general characters are very different from that of the clay slate in the northern division, as we partly indicated in treating of the physical geography of that district. There is here no such regular sequence from granite upwards, nor no superposition of this clay slate to mica slate and gneiss, as so often occurs there. In fact, its real geological connections and positions are as yet very obscure; but in this it partakes with Wales, the Isle of Man, Cornwall, and Cumberland, which, in all important particulars, it resembles. It is probable that it must be esteemed, like those, to follow immediately on granite, with few or scanty portions of other rocks interposed; and that there is thus but a brief and imperfect series between the lowest of the primary and the lowest of the secondary rocks.

In its mineral character also, it somewhat differs, as it does in the accuracy of its stratification and of its lamination, or fissile tendency. Hence it is difficult to discover and pursue the stratification; and as the laminar tendency is equally rare, or irregular, or obscure, it seldom is capable of affording roofing slate. Yet we must observe that it has not been sufficiently examined for this purpose, and is indeed, in most places, scarcely suspected of being the very substance from which slate is generally procured. With respect to its quality or texture, the coarser kinds, formed of fragments more or less minute, prevail very much; yet these are susceptible of being wrought for slate, as they actually are in Cumberland; while even among the coarsest rocks, beds of a perfectly fine quality are often interposed.

To define this great tract of clay slate to the northward, it is necessary to commence with St. Abb's head, and to pursue the course of the Lammermuir hills, still continuing to skirt the mountains till we reach the sea coast near Ayr. Hence westward, eastward, and southward, Scotland alone is its boundary, if we except the intrusions of the northern coalfield, the red sand stone, of both kinds, beneath the coal in one case and above it in the other, which enters near Berwick from England, as well as into Roxburghshire along the course of the Esk, at Jedburgh, and into Dumfries-shire or Galloway; tracts which we find ourselves unable to define in words by any species of topographical reference.

The granite already mentioned is also, of course, excepted. The general elevations and characters of this country were formerly given, and we may thus terminate the history of this important rock in Scotland.

Among the primary rocks, besides limestone, it remains to notice one or two which occur in very small quantities, and which are rather objects of geological curiosity than of general or economical interest.

The first of these is serpentine, sparingly dispersed everywhere, though found in many places. One of the most remarkable, and the most extensive tracts of this rock, occurs in the Shetland islands, where, however, it is nearly limited to the two northernmost, Unst and Fetlar. It here forms a body of considerable extent, stratified among the other primary rocks, and accompanied by diallage rock. It forms lofty and bold broken cliffs, and rises into hills considerable for these islands. It is chiefly remarkable here for the minerals which it contains, of which chromate of iron is the most conspicuous; a substance which might have been of great value in the arts of dyeing and colour-making, had not the market been more easily supplied from America. It also produces two rare minerals, the hydrate of magnesia and oxide of chrome, of which the latter has hitherto been found nowhere else. As far as has yet been observed, it contains no ornamental portions, being generally of a uniform dull green; but it is very possible that these may exist in it.

As the diallage rock is known only here in all Scotland, we shall now mention it, that we may not have to recur to Shetland again immediately. This rare substance is intimately associated with the serpentine, forming the whole of the small island Balta, and parts of Unst and Wya, and being found also in very small portions on the mainland of Shetland.

In the Western Islands, serpentine occurs in the island of Scalpa, the seat of the lighthouse on the east coast, and also on the neighbouring shore of Harris. Otherwise, it does not appear to have been observed in the islands, if we except quantities exceedingly trifling in Iona and Sky.

On the west of Sutherland, it occurs in three or four places, dispersedly, and in very small quantities, interstratified with gneiss; and here also, as in Scalpa, it is without beauty. That of Portsoy is the next conspicuous mass known; and it is familiar from having been long, though scantily wrought. In early times it was exported to France; and ornamental architecture from it is said to be still existing at Paris. It is not now encouraged; though, from its very great variety and beauty, and from the facility of quarrying and shipment, it might be rendered profitable, as well as ornamental, were it to obtain a fashion. Geologically speaking, it seems to be interstratified with the slate, gneiss, and quartz rock of the same locality; but it is not easy to ascertain this satisfactorily, as it appears in itself to be but an irregular mass.

In Aberdeenshire there are numerous independent asses of serpentine scattered about the country; but he greatest number of them are very small; and one are extensive. They are, in some cases, singulary connected with granite, and at others appear to be hort strata, including schistose rocks. The masses ear Kildrummie and Glen Kindie seem the most extensive, and they afford considerable quantities of asestos. Serpentine also occurs in connexion with trap, d otherwise, on the confines of the mountains of ngus; and at Clunie in Perthshire it presents the rare d interesting phenomenon of a transition into trap, rming the sides of a vein of that substance. The last ass of this rock which we are acquainted with in cotland, is found on the west coast, between Girvan d Ballantrae.

Chlorite schist is so little distinct in general from icaceous schist, that we have not thought it worth while hitherto to distinguish the two; but we cannot help pointing out to geologists a singular series of this rock on the west coast of Argyllshire; although, as the details are too minute for our article, we must refer to the work on the Western Islands formerly named, where there is a somewhat minute description of it.

Limestone, primary.

It remains to point out the primary limestone of Scotland, which are, like some other rocks, so dispersed, and in such minute quantities, that we scarcely know how to refer to them, but shall, as usual, commence with the Shetland Islands.

They are here very numerous, though seldom extensive; being interstratified with the other primary rocks, and found in almost every place. The largest apparent mass in one place is that at Stromness Voe; and next in importance are those of Tingwall, the Outskerries, and a few other places, for which it will be best to refer, as usual, to Dr. Hibbert. The geological appearances are sometimes interesting, particularly in Burra, and in other places where granite occurs: but they precisely resemble those of Glen Tilt. Economically speaking, Shetland has not yet derived the advantages from its limestone, in agriculture, which it might have done; but that is not to be wondered at, where this art is so backward, and encumbered with so many political and physical impediments.

In the Western Islands primary limestones are rare. With exceptions too trifling to name, they are found only in Lismore, Tirey, Iona, the Garveloch isles, and Isla. The marble of Tirey is familiar; but the working of this quarry has long been abandoned for want of a demand. It is a lump lying in gneiss, and is attended by a similar one of a beautifully white marble, often spotted with green, hitherto unnoticed. The white marble of Iona is equally well known; but it has long been exhausted. We already noticed that of the Garveloch isles as a possible branch of commerce; and need only here add, that it is accompanied by mica slate. We also mentioned that of Lismore at the same time; but this variety is of no beauty, being blue, and interstratified with clay slate, as are the corresponding strata in Appin. In Isla the limestone forms an extensive tract, and is noted for containing lead mines, which were formerly wrought.

In examining the limestone of the Mainland, we must commence with Sutherland, as it contains the most extensive tracts of this rock. The westernmost of these is found at Diurness, occupying the bay to a considerable extent inland, and forming a small island off its entrance. Though we have here enumerated this with the primary limestones, it is rather our opinion that it belongs to the secondary, and is analogous to the lowest of these, or to the mountain limestone of English geologists. It contains a subterranean cavern of some interest, called Smow, giving passage to a river which plunges into it about a mile inland, to re-appear at the sea shore.

In Loch Eribol there is another tract of the same rock, but of less extent, most conspicuous in a small island at the upper part of this bay. Another of still greater extent, and among the largest in Scotland, is found in the parish of Assynt; and we have already noticed it as formerly wrought for ornamental marbles. This portion occupies the whole of the valley in which it lies, connected with quartz rock and gneiss like the former; and the ornamental varieties are a black bituminous limestone of a small crystalline grain, varied with red or white calcareous spar. Not very far from this, at Lead Beg, there is a much smaller tract, which produces some pure white marble. An attempt was also made to work this; but no large or useful blocks were ever raised.

We must now pass over a great number of small strata scattered here and there in various places south of this, because we find it utterly impossible to indicate their situations; but we must here remark, partly as an excuse for this omission, and partly as a geological fact, that such strata are very often not a great many yards wide, and most frequently can scarcely be pursued for half a mile; while having no geographical or political marks near them, there is no mode of indicating their places. For this reason we can only say generally, that such strata occur in various parts of the mountainous districts, generally associated with gneiss, as that is the prevailing rock, and sometimes with mica slate or quartz rock, very rarely with granite.

The most conspicuous among the few which we can point out, lie above Glen Kindie, near Portsoy; or Coreen, near Loch Laggan, near Balahulish; or Rannoch, near Aviemore; and so on. In our account of PERTHSHIRE, we have already detailed at some length the most extensive of those which occur in the middle and south Highlands, commencing to the north of Braemar in Aberdeenshire, stretching through Glen Tilt and Blair, and crossing by various branches over to Loch Earn. Other parallel branches are found to the south of Killicrankie, in Strath Airdle, and various other parts; the whole presenting a singular prolonged range, combined with an equally singular interruption and ramification.

On the western shore, some slender portions are found in various places; and a tolerably conspicuous one occurs in Knapdale, occupying among other places the small island of Dana. Of other strata scattered in this neighbourhood through Cantyre, we shall notice that only near Campbelltown, conspicuous for its extent, and also for the singularity of its crystalline texture. Yet we should not neglect that of Appin, which may be considered as connected with the great tract of this rock found in Lismore, and which, with little effort of geological continuity, may be considered as prolonged to Isla.

The indications of primary limestone in the south of Scotland are so very rare and slender, that they are undeserving of notice.

Secondary rocks. Old red sandstone.

We now arrive at the secondary rocks, and, as first in order, at the lowest or old red sandstone. This occupies a very conspicuous, and often a very continuous extent in Scotland; but we shall commence from the north, and with the Shetland islands.

Here, the whole island of Foula, with the exceptions of granite and gneiss lately mentioned, is an entire mass of this rock, rising to a mountainous height. On the eastern coast of the Mainland of Shetland it also forms a continuous tract, and occurs in a scattered manner in one or two other places on the western shore. The Orkney isles must be considered as formed fundamentally of this same rock. Among these, Fair isle is conspicuous from the cliffs by which its stratification is displayed, and from the comparative purity in which it exists. In all the rest it is intermixed with shales, and often to such an extent, that this far predominates, while many of the islands possess no sandstone whatever. Here also its character is considerably different from what it is in Shetland, being more tender, and commonly of a dark grey or red.

In the Western Islands a minute portion occurs in Lewis; but elsewhere it is known only in Sky, where the quantity also is not considerable. That of Arran and Bute is indeed conspicuous; but these islands, as well as the great Cumbray, belong in this case, geologically, to the adjoining mainland.

Resuming the sandstone of Orkney as a leading point, we find the same rock occupying the northern shore of Caithness, and extending down the east coast towards the Ord, where it ceases for a time, while it also extends a considerable way into the interior country. Near Thurso it affords excellent slates of large dimensions, with flag stones, from the shales which are interstratified with it.

Every where, we need scarcely remark, it affords, or might afford, excellent building stone.

Resuming this rock again from the ord of Caithness, we find it renewed beyond the Fleet, occupying a very wide tract on this shore, including Cromarty, and sketching down as far as the Moray Frith and Beauley. We must, however, observe here, that this portion is less continuous and less defineable than that of Caithness, as masses of gneiss, often of great extent, intrude into it in many places, and as it also ramifies into some of the remoter Highland vallies, as towards Strathpeffer. On no part in this side of Ross and Sutherland does it rise into high mountains.

On the western shore its aspect is far different, while its intricacy is such as to be indescribable; being dispersed about among the gneiss and quartz rock of that shore, so that while in some places it extends for many miles without interruption, in others it occupies patches of only a few hundred yards in extent. Here also it rises into lofty mountains, Kea-cloch, formerly described as one of the loftiest of the Scottish hills, being formed entirely of this rock from the sea to the summit. Its general mineral character is here also different, as it is almost invariably red and of a much harder texture. Moreover, on the eastern shore, its outline is tame; but here it not only produces some of the highest mountains, but the characters of these are rugged, precipitous, and often peaked and serrated. We already remarked the singular insulation of some of these hills; and as we must here add that the strata are generally at low angles, and often nearly horizontal, it is evidently indicated that there has been a considerable waste or loss of rock, in consequence of what, in geological language, is called denudation.

Though we do not pretend to define this intricate boundary, we must say that it forms a kind of belt along the western shore, sometimes skirting the sea coast and sometimes retiring inland, which extends nearly from Cape Wrath to Glenelg. Where broadest, this belt is about thirty miles wide, and where narrower, it sometimes does not reach to a mile; while, in some parts, it is altogether wanting. It also forms the chief of the Summer Islands. In this connexion it almost invariably succeeds to gneiss, but sometimes to quartz rock; and in both these modes it sometimes forms mere summits, or caps on lofty mountains. Coul-beg is a very singular form of this kind, as is Suil-Veinn. We must also observe that it passes Cape Wrath so as to appear on the northern shore. Here, and on the west coast, it produces some insulated stacks, or steeples, of great elevation, as well as of elegant forms, of which Stackaclod is peculiarly remarkable from its twinned shape.

We must now return to Inverness, where we find this sandstone again as a continuation of that of Cromarty, occupying the country about Inverness itself, and reaching eastward beyond Speymouth, where this particular tract terminates. To the south, it sketches along Lochness, and chiefly on the eastern side, where it again terminates; while on the other shore, a very scanty portion only is found. It is here well known for the very great tract of conglomerate or pudding stone which belongs to it, and which is a subject of remark to all travellers.

Following this portion of sandstone still eastward, we find one narrower region of it occupying a small portion of Aberdeenshire; and with this may be said to end all the sandstone of this character that belongs to the Highland district.

We thus arrive at the most extensive tract of all; namely, that which forms an entire belt across the island, nearly marking the separation between the Highlands and Lowlands, and reaching from sea to sea. The northern boundary of this is so nearly coincident with the southern one of the slate belt formerly described, that what marks the one will define the other. If for its breadth we commence on the east coast, we may consider it as bounded by the Tay, and thus extending in a very irregular line, much interrupted, and covered by trap rocks in several places till it reaches Cantyre, thus including Arran and Bute, and skirting the southern shores of the Clyde beyond Greenock, till it is also there obscured by the trap rocks of that country. In Cantyre, it similarly terminates in a few insulated portions, marking an extent of superficies once more considerable.

In many parts of this tract quarries are wrought, and they might be opened in many more by those who are yet unaware of its immediate vicinity, and thus send to distant quarries for what lies at their own doors. The celebrated quarries of Kingudie lie in this rock. We shall only here further remark, that it varies much in its general character, being often grey or white as well as red; and it is equally variable in hardness.

If we now examine the south side of the Frith of Forth, we find another considerable portion which bounds with the slate of the Lammermuir, and reaches towards Edinburgh, where it sinks beneath the coal strata. This portion is very familiar at Dunbar. It appears yet unsettled by geologists whether all the red sandstone of Lanarkshire belongs to the superior strata, or whether some may not belong to this, and thus for the present it must remain.

Equal disputes have existed respecting those portions which appear in the south of Scotland; but they will probably be easily settled. On Mr. Bald's authority we have to state, that the red sandstone of Dumfries-shire is beneath the coal, and it must therefore belong to this rock. That in Eskdale is above it, and belongs consequently to the red marl of England, as must that of Roxburghshire, and probably of Berwickshire, since coal has now been found beneath certain parts of it.

We thus arrive at the coal strata, which are, with little exception, the uppermost of the stratified rocks of Scotland. We have already referred to Mr. Bald's article for the minuter parts of this subject, and shall therefore merely indicate the general places and extent of these strata.

The coal field of Sutherland is the most northern, forming a very narrow belt along the shore at Brora. It possesses this great singularity, that it lies almost immediately on granite, and sometimes in absolute contact. There are three beds of coal, of which one is wrought; and except that it contains perhaps an unusual proportion of limestone, it does not materially differ in apparent character from other coal fields.

The next independent portion we shall notice is that of Campbelltown, occupying a very small space on the western shore, and containing one bed of very indifferent coal. It appears to lie immediately on mica slate, but displays no peculiarities which we can here afford to detail.

The most troublesome and worthless, yet perhaps to a geologist the most interesting, is that collection of coal strata which is dispersed through many of the western islands, and for the minuter details of which we must again refer to the work formerly mentioned. This is found in scattered fragments through Sky, Rasay, the Shiant isles, Egg, Muck, Mull, and Morven; but it no where produces workable coal; though some trifling portions have been raised in Sky and Mull. It is by means partly of the trap rocks by which it is overwhelmed and intersected, and partly by its insular position, that its connexions become so difficult to trace, and further, that whatever coal it may contain is worthless. When the coal itself is not found, this field is traced by the limestone beneath it and in it, by its sandstones and slates, and occasionally by the coal itself. Of this latter there are numerous indications in Sky as well as in Mull; and it also appears in Morven in the very singular situation as formerly mentioned, insulated as the summits of mountains of gneiss.

On these three latter, we must now, however, remark, that we do not consider them as belonging to the proper coal formation immediately to be described, but to be situated in the strata above, instead of below the magnesian limestone, and apparently in the lias, or some analogous member of the oolithe series. Thus, according to our views, they must be ranked with the lignite formation, in which also we place that of Yorkshire, to which they seem analogous.

The great and valuable coal field of Scotland is that which is well known for its workings. The northern limit is also the boundary of the red sandstone already described, and from this it crosses to the similar boundary south of the Forth, though in many places covered and obscured by ranges and hills of trap. From Edinburgh, it proceeds partly to the south of the Pentland hills, where it terminates, and to the north of these westward to Glasgow. Thence diverging into Clydesdale, it is interrupted by the trap hills of Renfrew and Ayr, reappearing on the western shore, till it terminates in the red sandstone and the slate of that district.

The last two portions are those already alluded to as found in the south beneath the red marl, and as we need take no further notice of these, so we shall say no more of this formation than that some very trifling portions of it are found in different places, as in Fife, in Forfar, in Clydesdale, and very unexpectedly on the north-western shore of the Highlands. In one or two places also, it is accompanied by equally minute portions of the magnesian limestone.

Thus we arrive at the last and uppermost of the Scottish strata, though we ought here to remark what we before omitted, namely, that in some places that limestone which in England immediately follows the red sandstone beneath the coal, also occurs in Scotland, though apparently less commonly. Thus, however, it may be seen to the south of Edinburgh, in various parts of Fife, and in the west.

Geology.

It remains to notice the trap and porphyry of Scotland.

Porphyry.

The greatest mass of porphyry is that which lies in the neighbourhood of Inverary, occupying a scattered but considerable space; and next to that is the mass which occurs in Glenco, well known, a dependency of which may be conceived to form the summit of Ben Nevis. We know of no other extensive masses which appear of equal antiquity, and the veins are far too numerous and scattered to admit of description. All the other porphyries we must rank with the later trap rocks.

Trap.

Of these, Shetland possesses one portion in the island of Papa Stour; but the Western islands display a great extent of the rocks of this class. St. Kilda is thus formed of augitic greenstone and syenite. Sky is entirely formed of the same rocks, with the exception of the south-eastern quarter, and of another small portion at Strathaird. Here there are all the varieties of this family, and among the rest, that rare substance hypersthene rock, already mentioned. As dependant on Sky, we may name Rasay, partly formed of porphyry, the Shiant isles, Canna, Egg, Rum, and Muck. Egg also contains pitchstone; and its celebrated Scuir was formerly noticed.

Mull is the next great trap district in the islands, being almost entirely formed of it, and including the adjoining islands, excepting Inch Kenneth, of which Staffa is especially noted. To the south, Kerrera is also chiefly formed of trap, with part of Seil; but after this we meet with nothing further than veins, till we arrive at Arran, about one half of which consists of the rocks of this class. In the Clyde, Ailsa, the smaller Cumbray, and the southern point of Bute, are of the same materials.

In the Highlands, the chief trap district is Airdnamurchan towards the west, and Morven similarly, both of them in this sense dependencies on Mull. The minuter portions occurring on the borders of the Highland mountains, can only be mentioned thus slightly. But to the south of these, in the middle district, the great range of the Sidlaw displays many insulated portions of it, as does this country generally; the mass becoming more continuous near Perth, to be renewed in the Ochil, and again in the Campsie Hills, till it meets the Highland mountains. The northern shores of Fife display a smaller range; and through this whole county even to Stirling, a crowd of summits and fragments impossible to specify, bespeak the once greater continuity of an extensive central tract of this rock. Thus also, North Berwick Law, Inchkeith, Arthur's Seat, the Pentland, and many more summits which need not be named, indicate the former wider connections and extent of a mass once lying over the coal field here, and reaching to the westward till it is renewed in a more continuous manner to the west of Glasgow and the confines of Ayr.

Such is a sketch of the positions of a rock, which nothing but a detailed and coloured map could render intelligible; while, for want of this, we must also omit all notice of the innumerable veins which maintain this general connection, and indicate the former greater extent of trap in Scotland. In the south, the rocks of this class become rare; and we need only here notice the Eildon Hills, and the Cheviot scarcely appertaining to Scotland.

Mineralogy.

The following list of some of the rarer Scottish minerals was drawn up by the writer of this article, and was first published in Dr. Brewster's *Journal of Science*, vol. i. p. 225.

QUARTZ.

Of this very common mineral, it is only necessary to notice the varieties which are rare, and which more particularly comprise those that present peculiarities of colour.

Foetid.—At Pol Ewe and Loch Greinord, on the western coast of Scotland. This is found in gneiss, forming veins, and the smell often resembles that of putrid sea weed. It is sensible only on friction, and diminishes when the specimens have been so long kept as to lose their water.

Green. Coloured by chlorite. In Bute; on the shore of Cowal; on the south-eastern shore of Jura, and on the north-western of Isla, opposite. This quartz forms veins in chlorite schist, and is always accompanied by common chlorite. Some of the varieties are so dark as to be nearly black. It has been mistaken for prase, from which it is essentially different. The following variety is the prase of the Germans.

Green. Coloured by green actinolite. Prase. I have found this variety only once, and it was in a very limited quantity even there. This was in a small island within, and not far from the entrance of Loch Hourn. As it is too insignificant to have a name in the map, I cannot direct mineralogists to it more accurately. This quartz is in veins, traversing actinolite schist; and, according to the quantity of the intermixed colouring matter, it varies from a very light to the usual dark green of this mineral.

Green. Coloured by the green earth of the trap rocks. In Rum, in Scuir-more, together with the heliotrope of that place. In Glen Farg, and in the hill of Kinnoul. It also occurs in Ayrshire; and generally, in this case, it is intermixed with other chalcedonies and agates.

Green. Coloured by an intermixture of green compact felspar. In Rona, (East) at Pol Ewe, and on various parts of the western coast of Ross-shire.

Pink. Opaque, and pink or flesh-coloured. Common quartz, coloured by an unknown ingredient. In Lewis, from gneiss.

Pink. Opalescent, or rather milky. In Coll; in Aberdeenshire, on the Buck of Cabrach. The latter specimens are nearly transparent. In Loch Maddy in North Uist.

Brown red. Transparent. Apparently coloured by iron. On the western coast of Sutherland, in veins traversing gneiss, between Loch Inver and the Rs Storr. In East Rona; in the Angus hills.

Brown red. Milky or chalcedonic quartz. At Gairloch in Ross-shire, in gneiss.

Purple or *lilac.* Opaque. In Shetland, near Selievoe, in gneiss.

Violet blue. Pale; opalescent. In Loch Maddy, in North Uist, in gneiss.

Purple. Crystallized; amethyst. In trap in the hill of Kinnoul, and elsewhere; found in the centre of agate nodules. In the hills of Mar, in granite.

Grey. Blue or French grey. Opaque. In Glen Tilt, in veins in gneiss; and in Aberdeenshire.

Grey. Blackish. Common quartz, irregularly transparent. In various parts of Aberdeenshire, and in Shetland.

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* Several new minerals recently found in Scotland, and others which have been separated from old species, are added to this list.—Ed.

Grey. **Blackish. Chalcedonic quartz.** In Gairloch, in Ross-shire; on Ben Lair in the same county, in gneiss. The colour varies from very pale to very dark blackish grey, and the specimens are also exceedingly various in their degrees of transparency.

Black. Common transparent quartz, apparently coloured by an intermixture of hornblende, just as it is sometimes coloured green by actinolite. The fine splinters are translucent. In Ben Lair, in Ross-shire, in hornblende schist; but it seems very rare.

Brown. Transparent quartz. The colour varies in intensity, but the colouring ingredient is not known. It is discharged by a moderate heat. It is found crystallized, notedly in Cairngorm, in granite. In Arran, and in Benna-Chie, in granite. In St. Kilda, in that syenite which is connected with augite rock and greenstone. At Killin, perfectly transparent, but uncrystallized; in nodules in chlorite schist. In North Rona, in granite veins, uncrystallized.

Yellow. A brownish yellow crystal occurs in the hills of Mar. Yellow quartz, imperfectly transparent and full of fissures, is not uncommon in the Perthshire hills, but it seems in general to have been coloured somewhat recently, by having admitted a stain from the rust of iron.

Colourless or greenish. White amethyst. In Fife, and in the hill of Kinnoul.

Colourless. Transparent. The crystallized kind is too common to deserve notice; but as it is rarely transparent when in veins and nodules, I may here remark that it occurs in this manner in the chlorite schist, at the south-eastern extremity of Jura, and the north-eastern of Isla.

Granular white quartz, resembling refined sugar, is found in Harris, and in Ben Lair, in veins traversing gneiss. There is here also found a singular variety, in which a purely hyaline quartz passes gradually into this snow-white and finely granular kind. It is unnecessary to point out the localities of the other varieties, which abound everywhere.

FELSPAR.

As in the case of quartz, I shall here only notice the most remarkable and most rare varieties of this mineral. I may remark, generally, that they are principally found in those districts which consist of gneiss, and are almost always integrant portions of the granite veins with which that rock abounds.

Pure white. Opaque. At Hillswick, in Shetland, intermixed with actinolite, and very splendent. At Cape Wrath, in granite veins. In Coll, Harris, and in Arisaik.

White. Translucent where thin; splendent and reflecting much pearly light from the interior. This very beautiful variety occurs in Harris, on the southern side of Roneval. The ordinary white varieties, under many different aspects, are too common to require particular notice.

White. Crystallized. In Cairn Lia, one of the summits of Ben-y-gloe, in micaceous schist. In Aberdeenshire, not very uncommon; particularly in the granite of Bennachie.

Flesh-coloured. A brownish flesh-coloured variety, characterized by a high degree of transparency, and pearly lustre in the thin fragments, occurs in east Rona. A very beautiful yellowish flesh-coloured and similarly splendent variety abounds in North Rona. This colour is here distinguished for its peculiar purity and beauty, compared to the ordinary colours of felspar.

Blue-grey. This variety also abounds in North Rona, but I have never observed it elsewhere.

Brick-red. Very bright. This occurs in Lewis, in Ardgower, and in Shetland, but is rare. Reds declining from this in brightness and purity, are too common to require notice.

Purple-brown. In Eriska and Fudia, and less perfect in Coll.

Brownish-grey. Inclining to purple in some instances, and resembling that of a Labrador, but not iridescent. In Sky, in veins in hypersthene rock, and in Rum. In Aberdeenshire.

Glassy Felspar. In the basalts and clay-stones of the western islands in general. Very large in the clay-stones of Blaven in Sky.

COMPACT FELSPAR.

Compact Felspar.

Bright green. In Iona, and in Tirey, in gneiss. Very abundant in the same rock at Loch Greinord, and generally on the western coast of Ross-shire. In different parts of Inverness-shire and Aberdeenshire, but more rare. This mineral has hitherto been mistaken for quartz and for epidote.

Lead-grey. In Loch Maree, in Ross-shire.

Brown-purple. At Pol Ewe in Ross-shire. These two resemble precisely the compact felspars of Sweden.

White. In Iona. In West Rona, in North Uist. This is an extremely beautiful substance, and it also occurs in Sweden; but I have never yet seen specimens from any other place or country.

HORNBLENDE.

Hornblende.

Crystallized in East Rona; also in Ben Lair.

Platy and *splendent.* Dark green, resembling diallage; in Coll.

Fine fibrous. Resembling black satin, in Perthshire. In general it is too common, under its ordinary forms, to require further notice here.

Fine fibrous radiated. In clay-slate at Beharm, in Banffshire. This is a very singular and beautiful variety; putting on many remarkable forms, and, as far as I know, peculiar to this spot.

Pargasite. In Tirey, in white marble. The characters are extremely well marked.

ACTINOLITE.

Actinolite.

Intermixed in large crystals. Either alone, or imbedded in talc. In Glen Elg near Eilan Reoch. In Isle Oransa in Sky. At Hillswick in Shetland.

Fibrous. Continuously straight, curved, or undulated. In Glen Elg, and in Aberdeenshire.

Schistose. In Glen Elg; very finely laminar. In Sutherland, in Shetland, in Nether Lorn.

Short fibrous entangled. In Glen Elg. In Isle Oransa. Near Fedaland in Shetland.

Flat platy, entangled. In Isle Oransa.

Finely stellated, entangled. Near Fedaland in Shetland; near Blair in Atholl.

Nearly pulverulent, and *very pale.* In Shetland, near Burra Voe. The stellated and this last are extremely beautiful and singular minerals, to which I have seen no resemblances among foreign specimens.

Nearly white. Crystallized entangled. Near Handa in Sutherland. In this case there is a near approximation to tremolite; and it may even be doubted whether there are any essential differences.

Tremolite.

TREMOLITE.

In large crystals openly entangled and independent. In Tirey; from primary limestone.

In large crystals imbedded. In Glen Tilt.

Large fibrous, radiated or straight. In Glen Tilt. Of very large dimensions.

Flat bladed, radiated. In Cairn Lia (Ben Gloe), in Unst (Shetland.)

Fine fibrous, radiated or straight, In Glen Tilt, at Portsoy, in serpentine; at Dunkeld, in clay-slate.

Fibrous, asbestiform or silky. In white primary limestone. In Glen Elg.

Small stellated, imbedded. In Glen Tilt.

In imbedded and radiated spheres. In Glen Tilt.

In short fibrous crystals, compacted into a solid mass. In Glen Tilt. This variety sometimes appears to be almost granular. The specimens of tremolite, in this locality, all occur in primary limestone, and are very splendid; and most of the several varieties here named are so rare that I have seen no parallel to them in foreign collections. It is remarkable, that in Tirey, crystals of tremolite and of Sahlite are so confounded, that a single crystal sometimes contains both substances, as if there was a transition between the two minerals.

Heliotrope.

HELIOTROPE.

Chalcedony, coloured by green earth. In Scuir-more in Rum. In nodules, in the trap conglomerates of Kerrera. In the hill of Kinnoul; in Ayrshire; in Mull, under Gribon. On the beach at St. Andrews, loose.

Diallage.

DIALLAGE.

In Unst and Fetlar, in serpentine and in diallage rock. In Balta, in diallage rock. In Ayrshire, in serpentine.

Staurotide.

STAUROTIDE.

In Bixeter Voe, Shetland, in micaceous schist. The crystals here are as large as those of Britanny.

Hollow spar.

HOLLLOW SPAR.

In micaceous schist near Balahulish. This mineral occurs abundantly in Skiddaw, in clay-slate, as is well known; but I have never found it in Scotland, except in the above-mentioned place.

Apatite.

APATITE.

In the greenstone near the southern extremity of Salisbury Crags, near Edinburgh. In Ross-shire, near Bonar Bridge, in gneiss and granite. In trap, (claystone) in Rum.

Hypersthene.

HYPERSTHENE.

In Sky, and in Ardnamurchan, in hypersthene rock. In Rum, in veins in augite rock. It appears also to have been found loose in Banffshire; but its native place has not even been conjectured.

Staurolite.

STAUROLITE.

At Strontian, in a granite and metalliferous vein. In the Kilpatrick hills, in trap. It is not crossed or twined in either of these places; but the crystals are of great magnitude.

Pinite.

PINITE.

In Ben Gloe and in Forfarshire, in porphyritic veins. In Argyllshire, in massive porphyry. In these cases it forms an abundant ingredient in the rock, and has been mistaken for mica.

SPODUMENE.

In Glen Elg, in granite. In this case it is an ingredient of the rock, generally diffused with the felspar, mica, and quartz.

CYANITE.

In Shetland, at Hillswick, and in the southern promontory of Mainland, in mica slate. In Glen Tilt, in quartz. At Boharm in Banffshire, in clay slate. This last is the locality where the mineral was first found; whence it was sent to Saussure, and by him named Sappare,—a term corrupted from Sapphire by the person who transmitted it.

GARNET PRECIOUS.

At Strontian and in Ardgower, in granite and gneiss. In Harris, in gneiss. At Ely in Fife, loose. That of Strontian resembles the Hungarian in colour. That of Harris resembles the Greenland and the Indian garnets.

TOPAZ.

Blue, white, and brown. In decomposed granite in Braemar, loose. Single crystals weighing fifteen ounces have been found. A fragment in my possession belongs to a crystal which must have weighed eight pounds when entire. The blue and brown are sometimes united in one crystal.

BERYL.

In the same situations and place. The topaz is tolerably abundant; but this is rare, and the crystals imperfect generally, as if carious or corroded.

CHLORITE CRYSTALLIZED.

In Cairn Lia, in micaceous schist. In Jura, in chlorite schist. In Bute. At Dunkeld. The crystals of Cairn Lia are very large and perfect, being compounded hexagonal prisms terminated by pyramids.

FLUOR SPAR.

In Sutherland and Aberdeenshire, in gneiss and granite. That of Sutherland is purple. That of Aberdeenshire is most commonly green and white, and the green colour is discharged by exposure to air. At Strontian, in a granite and metalliferous vein. In Ayrshire, and in Papa Stour in Shetland, in claystone amygdaloid. This last situation is very rare.

CHLOROPHÆITE.

In Rum, in claystone and basalt; and near Burntisland in Fife. I found this mineral first in 1810. It varies in lustre in these two localities, the former being transparent when first found.

CONITE.

In Glen Farg, in Mull, in Sky, and in the Kilpatrick Hills, in amygdaloidal trap. These are the only places in which I have yet observed this new mineral.

PREHNITE.

In gneiss, in Yell, Shetland. In traps in the following situations. At Bishoptown, near Paisley. In the Kilpatrick Hills. In Glen Farg. In Mull, Sky, Arran, and Rasay. In Edinburgh castle rock, and in Salisbury Crags. In Dumbarton castle rock.

LAUMONITE.

In Sky, near Loch Brittle. In the Kilpatrick Hills.

APOPHYLLITE.

In Sky, near Loch Brittle. In the Kilpatrick Hills.

STILBITE.

In Sky. In the Kilpatrick Hills. Near Stonehaven. In Fife. In the Shiant Isles. In Staffa and Canna. In all these places in traps. In Arran in granite. At Strontian in a granite vein. In Kerrera, red, in argillaceous schist; being the only instance, I believe, of that association.

ANALCIME.

In Sky, Canna, Staffa, Ulva, and Mull. In the Kilpatrick Hills. In Edinburgh castle rock, and in Salisbury Crags. In Dumbarton castle rock. In Sky it is often transparent. In the Kilpatrick Hills it passes by a complete transition into prehnite. The primitive form occurs at Talisker, in Sky.

MESOTYPE.

In Glen Farg. In Sky. In Arran, the Shiant Isles, Staffa, and Ayrshire.

NADELSTEIN.

In the Kilpatrick Hills. In Sky. In Arran. The radiated variety, called natrolite, occurs in Staffa, and near Burntisland in Fife. The nadelstein of Talisker and Dunvegan in Sky, often resembles the finest cotton, or flaw silk, and is so light as to float in water.

CHABASIE.

In Sky, at the Stoor, and at Talisker, in traps.

WAVELLITE.

In the Shiant Isles, in an indulated shale or flinty slate of the secondary class, which belongs to the coal strata of the Western Islands, and is indurated by the vicinity of trap.

OLIVINE.

This is rare in Scotland. In Sky, in trap, near Loch Brittle; forming half the mass of the rock.

ADULARIA.

In granite in Arran. In granitic veins in micaceous schist in Cairn Lia. This mineral is very rare even in those localities.

AUGITE.

In Rum, in trap rocks, with felspar; very remarkable, and of a very large size. In St. Kilda, Arran, Sky, &c. in a similar manner. In Tirey it is found in white primary limestone, and sometimes regularly crystallized.

SAHLITE.

In Tirey, often crystallized, and of various colours, forming very beautiful specimens. In Harris equally or more various, and often of a dark brown. In Glen Elg, silvery white. In Rannoch, pale green. In Glen Tilt, white, massive, in large beds; where it is associated with tremolite, as it also is in Tirey; decomposing also into a very tenacious and unctuous clay.

Andalusite.

ANDALUSITE.

In Aberdeenshire, in granite.

CALCAREOUS SPAR.

Calcareous spar.

Green. Coloured by green earth, of a light green. In Rum. Of a dark green, by common chlorite in Bute. Those varieties are extremely singular and rare.

Yellow. Crystallized in the inverse rhomb. In the primitive rhomb. In Sky also. The varieties found at Strontian are so well known that I need not enumerate them.

HYDRATE OF MAGNESIA.

Hydrate of magnesia.

In Unst in Shetland, and in Balta. Found in serpentine and in talc schist.

OXYDULOUS IRON.

Oxydulous iron.

Octahedral. In hypersthene rock in Sky. In talc and in chlorite at Fillswick and at Unst in Shetland. In chlorite schist in Bute.

Micaceous. In veins or nests, in clay slate, at Dunkeld. In dispersed grains, in gneiss and granite, in Shetland. In the same manner in a compact grey (*old red*) sandstone.

Specular-volcanic. In trap veins in Perthshire. This is crystallized in prolonged hexagonal plates, and resembles that of Vesuvius.

BOG IRON ORE.

Bog iron ore.

The resinous variety. In Foula, Shetland. This variety is not common, and resembles, in its lustre and fracture, those Hungarian jaspers which have been improperly called pitchstone.

OXYDE OF CHROME.

Oxyde of Chrome.

In Unst, in chromate of iron. This new mineral is the pure oxyde of chrome, not the mineral called by this name in Lucas's system; and is either compact or pulverulent, being sometimes green, at others yellow.

GOLD.

Gold.

At Leadhills. In Perthshire, at Turrich in Glen Coich.* At Leadhills in Lanarkshire. In Sutherland, near Helmsdale. In Perthshire, in the sands of the Tay.

SULPHURET OF MOLYBDENA.

Sulphuret of molybdena.

In Glen Elg.

BLACK LEAD.

Black lead.

In Ayrshire, at Cumnock. In Glen Elg. In Strathpeffer. In Shetland. At the head of Loch Lochy in Inverness-shire, within a mile of the Caledonian Canal.†

To the preceding list the following new or interesting minerals may be added:

1. SULPHATO-TRI-CARBONATE OF LEAD.

Sulphato-tri-carbonate of lead.

At Leadhills, in a vein traversing greywacke.

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* A specimen from this locality in the cabinet of Thomas Allan, Esq. weighs upwards of seven guineas.—Ed.

† See Dr. Brewster's *Edinburgh Journal of Science*, Vol. II. p. 97.

2. SULPHATO-CARBONATE OF LEAD.

Sulphato-carbonate of lead.

At Leadhills, in columnarly aggregated crystals.

3. CUPREOUS-SULPHATO-CARBONATE OF LEAD.

Cupreous-sulphato-carbonate of lead.

At Leadhills along with the preceding species.

4. CUPREOUS SULPHATE OF LEAD.

Cupreous sulphate of lead.

At Leadhills along with the preceding species.

5. BARYSTRONTIANITE.

Barystrontianite.

In clayslate at Stromness in Orkney.

6. BREWSTERITE.

Brewsterite.

In fine crystals of crystalline coats at Strontian in Argyllshire.

7. HEULANDTITE.

Heulandtite.

In the trap rocks of the Kilpatrick Hills near Dunbarton.

8. THOMSONITE.

Thomsonite.

In the trap rocks of the Kilpatrick Hills.

9. EDINGTONITE.

Edingtonite.

Associated with Thomsonite in the trap rocks of the Kilpatrick Hills. See Dr. Brewster's *Edinburgh Journal of Science*, Vol. III. p. 316.

10. WITHAMITE.

Withamite.

At Glenco in Argyllshire, in a reddish trap rock. See Dr. Brewster's *Edinburgh Journal of Science*, Vol. II. p. 218.

11. DATHOLITE.

Datholite.

In Salisbury Craigs, near Edinburgh.

12. CHROMATE OF IRON.

Chromate of iron.

In huge masses in the Shetland Isles, viz. Unst and Fetlar. At Portsoy in Banffshire, and in small granular masses in a greenish white marble, at Buchanan in Stirlingshire.

13. COPPER.

Copper.

Blair Logie, and Airthry in Clackmannanshire. In the Orkney Islands, at Fetlar, &c.

14. PRISMATOIDAL ANTIMONY GLANCE.

Prismatoidal antimony glance.

In the antimony mine near Langholm in Dumfries-shire, which is no longer wrought. At Leadhills.

15. SILVER.

Silver.

At Alva, in CLACKMANNANSHIRE, which see, in Vol. VI. p. 655, and in Peebles-shire. At Leadhills.

16. LEAD, SULPHURET OF.

Lead, sulphuret of.

At Leadhills in LANARKSHIRE, which see, in Vol. XII. p. 514. At Wanlockhead, in DUMFRIES-SHIRE, which see, in Vol. VIII. p. 195. At Strontian in Argyllshire. At Dollar in CLACKMANNANSHIRE, which see, in Vol. VI. p. 655. At all the above places it has been wrought. At Belleville, in Inverness-shire; and at Leadlaw, in Peebles-shire.

17. SULPHATE OF LEAD.

Sulphate of lead.

Leadhills, and Wanlockhead.

18. CARBONATE OF LEAD.

Carbonate of lead.

At Leadhills, and Wanlockhead.

19. COBALT.

Along with the silver at Alva. In CLACKMANNANSHIRE, which see, in Vol. VI. p. 655.

20. ARSENIC.

Ores of arsenic have been found in the Ochills in Clackmannanshire.

21. LAPIS LAZULI.

At Leadhills.

22. ELECTRIC CALAMINE OR SILICEOUS OXIDE OF ZINC.

At Leadhills and Wanlockhead.

CHAP. III. AGRICULTURE.

THE agriculture of Scotland forms an extensive subject, from its variety no less than from its very perfect state, where it is in an improved condition; but we must attempt to condense, within our very brief space, those practices by which it is particularly distinguished, since the entire subject would occupy a volume, as it has already occupied hundreds.

We may here distinguish it into the ancient and the modern, not merely because our ancient agriculture is matter of curious history, but because it is not yet expired, maintaining still far too great a hold over the practices of the Highlanders, with whom it chiefly remains.

In the ancient system of Highland agriculture, the lands were generally held in runrig, as a few yet are. In this practice many tenants were the joint holders of one farm, and their crowded houses formed the *towns*, which are still to be found in various parts of the country. Each man, separately as well as jointly, was responsible for the whole rent, and the whole was unenclosed, or ill inclosed, and divided into ridges; so that at the expiration of every year every man's lot was interchanged. The forcible interchanging has now ceased, though the division into ridges of a common field still continues. This was and is the infield, and is cultivated for ever, having all the manure that can be procured. The outfield is cultivated without manure as long as it produces the seed, and sometimes longer; and the pasture which was formerly an unlimited and free common, is now so far divided that each holder pays a rent per head for all the cattle of whatever class he may put on it; the numbers being also limited.

Such is the improved and present runrig system. The cultivation consists chiefly of a rotation of oats and potatoes, sometimes with barley or bear interposed, and very rarely with rye; besides which flax is occasionally cultivated every where. Grass is never sown; and in this purer system, turnips are unknown, though the turnip cultivation is now becoming a part of the rotation, on lands bordering on the lowlands, as pease also are occasionally. In the same lands we also now find clover, and occasionally vetches; but, in the remoter highlands, these are still unknown.

All rents are now paid in money, excepting some trifling and occasional dues in kind; and there are few servitudes except in the case of cottars. Yet, as we remarked when on the subject of manufactures, the kelp estates and the fisheries of Shetland and Orkney are wrought as servitudes; labour being paid in lieu of money, by a special and accurate agreement. In some places, also, particularly where the larger propri-

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etors reside, the carrying of peat forms a similar servitude, as does, more rarely, harvest work; a plan which reduces the small tenant partially to the condition of a cottar, but which is rendered necessary by the total want of hired labour, and the absence of a class which makes this a trade. It is very rarely that leases are granted to the small Highland tenants, whose farms average from three to five pounds annually; but they are seldom removed, except in cases of extreme misconduct, nor are their rents indefinitely raised on any eventual improvement of their farms. Should this happen, however, no *melioration* is allowed; and as they build their own houses without assistance from the landlord, this property, such as it is, falls in to him. Where the rents are paid in money, this is provided by the sale of cattle, or sometimes by the fishery; as there is no surplus produce from the cultivated land capable of paying a rent.

The prevailing system, however, at present in the Highlands, is that of separate tenantry, popularly called crofting. This system is partly the consequence of the division of the ancient runrig farms among the tenants upon them, and partly, and principally, the result of new settlements, consequent on the introduction of large sheep farms, and the accompanying migrations to the sea-shores. Thus, not only has a class of separated and sole tenants been introduced into the interior and old settled districts, but a great quantity of land before unoccupied, or ill-pastured by wandering cattle, has been rendered productive, and the seat of an entirely new population.

A croft is, in fact, a sole farm; and though, without lease, no way differing from the common classes of small farms in Scotland. But these holdings are very limited; being barely sufficient in most cases for the maintenance of a single family; while, in many situations, they are insufficient even for that, or are at least incapable of paying the rent and maintaining the family both. It is impossible to name the exact quantity of land, as that varies according to its quality; but from three to five acres of bad arable land, or of rocky land fit only for the spade, is a general average; while he unenclosed pasture is such as to maintain a few attle, and, occasionally, some sheep and the necessary orses. In this case, as the pastures are common in a ertain sense, each tenant's cattle are limited and paid or in the rent, by an allotted charge for each class.

The crofters also build their own houses, and often nder great difficulties and restrictions; not being al- wed the use of wood, though growing, nor suffered take a turf for covering; while, in case of removal, e labour is surrendered and lost. However bad the ltivation of these petty farms may be, it is better than der the ancient system of common holding, though t differing in the rotation, nor in the objects of culre. The tenant, knowing the exact extent and pows of his land, and profiting the next year by the laurs of the preceding, is enabled to bestow more curate attention upon it, is restrained from a waste- excess of useless horses, as was formerly the fashion, l manages his little stock of cattle to a better purse. There are many of these tenements so rocky t *they* can be wrought only by the spade, or the *chrom;* and thus many spots of ground that never ld have been occupied under the old system, have n broken up for cultivation, and are the seats of a population.

lence, in fact, the great increase of the general potion of the Highlands, and more particularly of that e sea shores. And it is to the sea shores that this modern system chiefly applies, while it originated in the sheep farming. In the interior lands, and in former days, the people were situated in the glens, and in such fragments of land in the mountains, as were adapted to the miserable cultivation there carried on, while the pastures were indiscriminately occupied by black cattle. But they were not half stocked in some places, while near the farms they were so overstocked, that the cattle were starved, and frequently died of want towards the end of the winter. Moreover, there are many places where cattle cannot tread from their weight, and which from their inactivity they cannot climb; while, besides all this, the necessity of winter pastures limited the number of cattle which could be kept on all the summer ones. All these difficulties and losses are removed by the substitution of sheep, which could eat what black cattle could not reach, or could not consume, and which, being sold off the breeding farms when the summer pastures were consumed, required much less winter food. Thus there was a positive ovation of food, and consequently of rent, we might truly say of land, by substituting sheep for cattle; and hence the great increase of value which the Highland estates experienced from this radical change.

But where so many thousand acres were thus occupied in one farm, it became impossible to suffer the glens and green pastures scattered about it to remain in cultivation and in other hands. The smaller tenants could not farm sheep, because these can only be raised and managed to profit in large flocks, and by great capitalists, while they also require a degree of attention which the small Highland tenants and shepherds have proved themselves incapable of giving. Hence the larger tracts of pasture necessarily fell into the hands of capitalists, and were allotted in large divisions; and thus also it became necessary to remove the small tenants, that the sheep farm might be preserved from interference, and that the arable lands within them which produced the only winter pastures, might be reserved in aid of these for winterings.

This was the new system which still continues, though not now capable of much further increase; and it was the system which produced so much clamour, and which originally led to those emigrations which excited so much groundless alarm. And as this system was the original cause of the crofting, the consideration of the one necessarily involves that of the other, and they are thus both conveniently considered in one general view.

In those cases where the holder of the interior rough lands possessed no sea shore, or no extent of separate arable land, emigration became an inevitable consequence of the change, because there was no place to which the tenants could be moved. But fortunately many of these holders also possessed sea shores, which were not only ill occupied, but could not be conveniently thrown into general pasturage, while, from their generally green nature, and fertile though rocky soils, they were well adapted to a system of divided and petty farming. Thus the proprietors provided settlements for their ejected tenantry, and at the same time added in two ways to the value of their lands and to their rentals, by raising the value of the pastures, and by an absolute creation of new lands on the sea shores. That value was indeed increased in a third and distinct manner; and hence a great additional augmentation not only in the rent, but in the population of the country.

The nature of this last increase may be already conjectured from our preceding remarks on the fisheries. It is quite impossible that any rent could be paid at all

Agriculture.

from nine-tenths of the maritime crofts, and from their own surplus produce; since, in fact, they possess none, and are seldom indeed sufficient to maintain the cultivation. Thus it is by fishing, that either a rent is produced, or that the farmer and fisherman is enabled to save from his farm a sufficient surplus to pay that rent. Hence the high scale of these rents. In any other situation the land would be worthless; and probably in none else would it pay twopence an acre, where it is now paying ten shillings or more. These lands are in fact accommodations for the fishery, and are more in the nature of town holdings than mere farms; and hence their high rents are really derived from the fisheries, however they may appear to be the rent of the land. We have already shown how the progress of this system is, by perpetual subdivisions, to reduce the system to one of mere fisheries, and thus to produce that effect so long and vainly expected from the erection of fishing villages.

These remarks on the peculiarities which still distinguish the agricultural system of Scotland, will be sufficient. The details that belong to its improved agriculture, will be found at great length under our article Agriculture.

Gardens and Orchards.

Gardens and orchards.

The celebrity of Scottish gardeners, and the perfection to which the higher class of horticulture has been brought in this country, are too well known to require detail or praise. We must limit our very few remarks to what is more purely of an agricultural or rural character.

The great increase of kail-yards or cottage gardens is of modern date, as is almost the introduction of these. Accordingly they are most numerous in the lowland and improved districts, being comparatively rare in the Highlands. They may be divided into four classes; namely, gardens held in fee, the gardens of farm servants in general, those held by artisans and labourers, and village gardens. The first are generally the largest and the best cultivated; and the rotation of crops is so managed as to ensure a perpetual produce. Cottage gardens being much smaller, have less variety of produce; and those of mechanics, with those found in villages, are generally tended with much assiduity. It is unnecessary to enumerate the common articles of produce; and it is only to be wished that a system so useful and profitable may be extended to those districts where it has hitherto been in a great degree neglected.

The principal market gardens are necessarily situated in the neighbourhood of the great towns. About 1771, the quantity of land so cultivated about Edinburgh was 126 acres; in 1812 it was 400, in the hands of seventy-six gardeners; the average size being between five and six acres, but the lots ranging from half an acre to sixteen. About a sixth of this ground is planted with gooseberry, currant, and raspberry; and from 50,000 to 60,000 Scotch pints of gooseberries are sold yearly. But besides this, there is a supply for Edinburgh, ranging to five or six miles, including Dalkeith, Musselburgh, &c. the space being estimated at sixty acres. The annual value of vegetables sold there, is estimated at from £16,000 to £18,000, which is at the rate of £45 an acre for every acre so occupied. The rent of this land at Edinburgh is from £8 to £16 an acre, little of it being below £10. We may here add, that the annual value of strawberries alone sold is under £4000.* This is a natural object of curiosity, from the great apparent profusion in which that fruit is supplied. We cannot here afford space to repeat these details as they relate to the gardens in the neighbourhood of the other great towns; while we are equally compelled by our limits to pass over what relates to the gardens of the opulent. Similarly, we have not room to do more than mention the botanic gardens of Edinburgh† and Glasgow; yet we cannot terminate this part of our subject, without noticing for praise the efforts of the Caledonian Horticultural Society, always engaged in works of usefulness, and as having added much to our valuable practical knowledge. An account of the various objects and modes of cultivation will be found in our article Horticulture.

Nurseries were almost unknown in Scotland till the middle of the eighteenth century; but they are now become numerous, and are generally of course situated near the great towns. At present, they are computed to dispose annually of ten or twelve millions of forest trees, besides fruit trees; so much has the taste for planting and gardening increased with the increase of wealth. These public nurseries are now estimated to amount to 700 acres; and about Edinburgh nearly 130 are thus occupied. The Scotch nurseries also export considerably to England, one house alone having sent to London 2,000,000 of seedlings within the year. The rent varies from £8 to £14 the acre, and in some places it is as low as £5. Besides the public nurseries, it is estimated that there are about 150 acres employed in this manner by private individuals.

The public, or market orchards of Scotland, are not very numerous; nor indeed are the private ones so when compared to the customs of England in this respect. This must be attributed to fashion or neglect, as there is nothing in the climate to prevent the extensive raising of apples at least, and there is no doubt that cyder might be made to advantage, particularly if, as in England in many places, the practice of gardening were combined with it, or the orchard made a portion of the garden. As we cannot here pretend to notice private orchards, we must slightly enumerate those which are intended for profit and sale, or are particularly remarkable for their extent or produce.

The greatest number of orchards are situated in the manufacturing districts, and chiefly in Clydesdale. Above 200 acres on the banks of the Clyde are thus occupied; and the fruit averages in annual value from £1500 to £3000. In the whole of Lanarkshire the number of acres is reckoned at 360, and the extreme annual value £5000. The average value per acre is £8 to £16, and on land which, without the trees, would produce only from 5s. to 30s. the acre. The sizes of the orchards are from four acres to thirty.

In the Carse of Gowrie there are about twenty orchards, and they are generally let, and kept also under a rotation of corn crops. The average rent of the fruit alone is from £8 to £10 an acre. There are a few also about Falkirk, and in the Carse of Stirling, as well as Aberdeenshire; and it is thought by able gardeners, that they might be established to great advantage in all the western Highlands, particularly in Argyllshire. We need not detail the modes of management, as they are not peculiar to Scotland, and as we must indeed consider this branch of rural economy as in a backward state in this country compared to England, or to its own rank in the more general departments of agriculture and horticulture.

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* See our article Horticulture, Vol. XI. p. 226.

† See Horticulture, Vol. XI. p. 184.

Plantations and Woods.

In our article Perthshire, Vol. XVI. p. 427, 428, we have given an account of the most extensive plantations executed in that county, and information of the same nature will be found in our other county articles. We must, therefore, content ourselves with a tabular view of the quantity of wood which Scotland is supposed to possess, both natural and planted, the authority for these statements being the several county reports.

State of the Natural Woods and Plantations of Scotland in Scotch Acres.

Counties or Shires.	Acres Planted.	Acres Natural.	Total.
1. Aberdeenshire - -	50,000	74,000	124,000
2. Angus or Forfarshire -	33,624	5,604	39,228
3. Argyleshire - - -	4,000	30,000	34,000
4. Ayrshire - -	26,000	6,000	32,000
5. Banffshire - -	12,000	6,000	18,000
6. Berwickshire - -	5,500	500	6,000
7. Caithness-shire -	250	600	350
8. Clackmannanshire -	2,000	900	2,900
9. Cromarty and Ross-shire	5,000	72,000	77,000
10. Dumbartonshire -	4,000	7,000	11,000
11. Dumfries-shire - -	28,000	3,000	31,000
12. Edinburghshire -	14,000	3,000	17,000
13. Elginshire - -	10,000	21,000	31,000
14. Fifeshire - -	18,000		18,000
15. Galloway - - -	4,400	3,800	8,200
16. Haddingtonshire -	4,500	400	4,900
17. Inverness-shire - -	10,000	45,590	55,590
18. Kincardineshire or Mearns	17,000	609	17,609
19. Kinross-shire -	1,993		1,993
20. Lanarkshire - -	4,430	2,150	6,580
21. Linlithgowshire or West Lothian	5,000	200	5,200
22. Nairnshire - -	4,000	8,000	12,000
23. Orkneys and Shetland -			
24. Peebles-shire - -	2,000	500	2,500
25. Perthshire - -	50,970	118,930	169,900
26. Renfrewshire - -	4,000	500	4,500
27. Roxburghshire - -	4,682	608	5,290
28. Selkirkshire -	2,000		2,000
29. Stirlingshire - -	10,000	4,000	14,000
30. Sutherlandshire -	1,173	3,000	4,173
31. The Western Isles, or Hebrides, including Arran, Bute, and all to the north-east as far as the Orkneys	5,000		5,000
In Scotch acres - -	343,522	417,891	761,413
In English Acres -	412,226	501,469	913,695

Waste Lands.

The quantity of waste or uncultivated lands in Scot- and is estimated at 13,900,550 statute acres, that of he cultivated being 5,043,450. Hence little more than quarter of Scotland is now cultivated; and of the emainder, although much is valuable pasturage, there also a great deal which is far less productive even in his respect than it might be rendered; while there is lso a very considerable extent which must for ever ontinue worthless.

Of lands reclaimable there are many kinds; but they re either mountain, or moor, or bog, or marsh, or ndy downs. To detail the various modes of improv- g these is impracticable in such narrow limits; and erefore we can only enumerate the following prac- ces, variously applicable, and by which, as Scotland vances in capital and power, much of the land will nquestionably be improved. These are, inclosing, aining, cultivation, irrigation, paring and burning, ploughing, bringing soil and manuring, rolling, flooding, planting, and lastly the entire removal of the surface as practised in Blair Drummond.

A great facility has been given to the improving of waste lands by the act of 1695, for dividing common rights; and those who will examine the state of Shetland where this practice has not yet been introduced, will speedily be convinced of its value. Thus, among other things, have the great pasturages been improved, and rendered many times more productive than they ever were, or could have been.

On Live Stock.

On live Stock.

As we have already treated of the subject of sheep pasturage, we shall now add a few words on the subject of the sheep themselves.

Sheep.

The original sheep of the Highlands was the Norwegian, or short-tailed breed, of which a few are still to be found in Shetland and in St. Kilda. This is a worthless race in every sense; the carcass being small, though the mutton is good, and the fleece, which is also coarse, seldom reaching beyond half a pound. This was first replaced by the black-faced breed, and that has now been followed by the Cheviot so extensively, that in no long time it is likely to occupy most of the great Highland farms. A few Merinos have been introduced, together with some half breeds from this; but they have not yet spread, and their superior value continues doubtful. The Leicester or Dishley breed is also cultivated. The methods followed by the great sheep farmers are so complicated in the detail, as to forbid our indulging in the description; but the greater farms in the north are frequently in the hands of English tenants from Northumberland, and the principal shepherds are almost invariably from that country.

In the islands, where sheep cannot bear transportation in certain parts of the Highlands held in smaller farms, or where the peculiar nature of the land renders it preferable, cattle farming is also extensively pursued, as it is in Galloway, and many other pastoral districts. The breeds in use are the two Highland varieties, the Galloway breed, the Fife breed, and the mixed breeds of the south-eastern counties. The ancient wild breed is so nearly vanished, as to be merely kept for ornament by the Duke of Hamilton, and one or two other gentlemen.

In the mountain districts, and in some other places, the trade is breeding, and the cattle are driven in a lean state to be fattened in the southern counties, where the demand lies, and in England. Dairy farming is not extensively practised in Scotland, and is chiefly limited to the neighbourhood of the great towns, and for home consumption. The principal, and indeed almost the only cheese manufactory is carried on in Ayrshire.

Horses.

With respect to horses, Scotland possesses many distinct breeds and of remarkable qualities; and though there was a period at which breeding was neglected, it is now fast becoming an object of attention, and is a trade which might unquestionably be introduced with advantage into many of the Highland districts. There are four distinct breeds of horses in Scotland, besides numerous varieties from each.

The Shetland is probably among the most original, and is well known. Neglected as it is, it is a strong and hardy race, as well as docile and good-tempered. It never requires the house, and will undergo incessant work without corn, while it will also carry weights

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equal to any horse of twice the stature. Of course, it has comparatively little power in draught. Those who know only the rough animal, commonly exported at prices of twenty or thirty shillings, are scarcely aware of the beauty of this race under careful breeding, often producing models on a small scale equal to the Arab.

The Highland horse is more variable, ranging from nine to twelve hands; and when they are perfect of their kind, they are handsome, docile, and persevering. Neglected as they are, however, it is seldom that fine patterns are met with; and it is too common for them to be half starved, while they are equally exposed to all the bitterness of weather far more severe than that of Shetland. The ponies of Mull are particularly in repute for their good qualities. The unnecessary numbers kept by the small tenants are very inimical to their good treatment; but this is an evil which is gradually disappearing.

The ancient race of Galloway is too celebrated to require more than a bare mention; but it has almost vanished. They are, when yet found, of twelve or fourteen hands high, compact and strong, and at the same time both active and hardy. It is to be regretted that a breed so much esteemed for the saddle is not revived before it is too late; but this will not happen unless this branch of rural economy, that of breeding horses for a market, shall soon make greater progress in Scotland than it has hitherto done. It is esteemed not to be profitable; but we are convinced that it is a branch of farming which might be rendered so in many of the ruder western districts.

The Clydesdale or Lanark race varies from fourteen hands to sixteen, and are much esteemed for farm work. Of the other varieties we cannot here pretend to speak. Yet we must remark with the more judicious, that the system of horse racing, intended ostensibly to promote and encourage the breeding and improvement of horses, does not deserve the encomiums commonly bestowed on it. The blood, or thorough bred horse of England, is a defective horse, excepting for the sole purpose of speed, and of speed within a short space and time; a quality of little or no value off the turf. As far as hunters' plates are concerned, a good variety of horse is cultivated, and it were prudent if these were increased to the exclusion of the others. The thorough bred English horse is not equal to the Arab whence he sprung; and his race has perhaps already done as much injury as good in England at least. He has been too much cultivated and crossed to the neglect of others; and hence the notorious difficulty of procuring good horses for the saddle and for the more general purposes. It is through this race that the vice of stumbling, for which English horses are so noted, has been propagated.

Before we conclude this account of the agriculture of Scotland, we shall give a tabular view of the nine agricultural districts into which Scotland has been divided.

I. *The southern arable district*, including Roxburghshire, and the three Lothians, which have been called the granaries of Scotland.

II. *The southern pastoral district*, including the counties of Peebles, Selkirk, Dumfries, Kirkcudbright, and Wigton.

III. *The manufacturing and commercial district*, including the counties of Ayr, Renfrew, Lanark, and Dumbarton.

IV. *The central district*, including the counties of Fife, Kinross, Clackmannan, Stirling, Perth, and Forfar.

V. *The north-east Lowlands*, including the counties of Kincardine, Aberdeen, Banff, Elgin, and Nairn.

VI. *The West Highlands*, including the counties of Argyle and Inverness.

VII. *The North Highlands*, including the counties of Cromarty, Ross, Sutherland, and Caithness.

VIII. *The Hebrides*, including the Western Islands of Scotland.

IX. *The Northern Islands*, including Orkney and Shetland.

The following table contains a general view of the extent and other particulars respecting these districts.

TABLE *of the Extent, &c. of the Nine Agricultural Districts.*

Districts.	Square miles of land.	English acres cultivated.	English acres not cultivated.	Total land in English acres.	Proportion in 100 cultivated.
I. The Southern arable…………	1903	684,980	532,940	1,217,920	56.24
II. The Southern pastoral………	3108	536,536	1,452,584	1,989,120	27.
III. The manufacturing…………	2434	723,116	834,644	1,557,760	46.2
IV. The central…………………	4552	1,354,934	1,558,346	2,913,280	46.5
V. The north-east Lowlands……	3653	826,368	1,511,552	2,337,920	35.4
VI. The West Lowlands…………	5104	312,655	2,953,905	3,266,560	9.6
VII. The North Highlands………	4766	296,236	2,754,004	3,050,240	9.7
VIII. The Western Isles…………	2800	262,257	1,529,743	1,792,200	14.0
IX. The Northern Isles…………	1280	46,368	772,832	819,200	5.7
Total………………	29,600	5,043,450	13,900,550	18,944,000	27.88 Mean.

	English Acres.
Cultivated land	5,043,450
Uncultivated	13,900,550
Loams	1,769,193
Rich clay soils	987,070
Gravelly soils	681,862
Cold or inferior clay soils	510,265
Improved mossy soils	411,096
Sandy soils	363,771
Alluvial haugh or carse	320,193
Total productive soils	5,043,450

The following Table shows the number of acres in one year, which are under different crops, and in fallow, grass, hay, and pasture.

Grass, hay, and pasture	2,489,725
Oats	1,260,362
Turnips	407,125
Barley	280,193
Fallow	218,950
Wheat	140,095
Beans and pease	118,000
Potatoes	80,000

Gardens and orchards	32,000
Flax	16,500
Rye	500
Total	5,043,450

The following Table will show the value of the above crops.

Grass, hay, and pasture, at £2 per acre	£4,979,450
Oats at £7	8,822,531
Turnips at £4	1,628,500
Barley at £8	2,241,544
Wheat at £11	1,541,045
Beans and pease at £6	708,000
Potatoes at £8	640,000
Gardens at £15	480,000
Flax at £8	132,000
Rye at £6	3,000
Total produce	£21,176,073
Uncultivated acres, including woods at 3s. per acre	2,,085082
Total	£23,261,550

The following Table shows the number of live stock.

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Horses	243,489
Cattle	1,047,142
Sheep	2,850,867
Hogs	500,000

The value of the produce of which is as follows:

Horses, annual value of their work £10 each,	£2,434,890
Cattle, annual value of dairy produce, and increase in the value of the breeding cattle £6 each	6,282,852
Sheep at 10s. each	1,425,433
Hogs at 30s. each	750,000
Lesser stock, poultry, &c.	250,000
Total produce of live stock	£11,143,175

We must now, however, bring this sketch to a close, and shall condense such information, as we could not otherwise have found room for in the following tables, which require no further explanation than themselves will furnish.

A TABLE *of the Prices of Labour in Scotland in* 1790, *and since* 1804.

Names of Counties.	Wages per Week in Winter.	Wages per Week in Summer.	Wages per Week with Board in Harvest.	Wages per Day for Women.	Wages per Week in Winter.	Wages per Week in Summer.	Wages per Week in Harvest with Board.	Wages per Day for Women Hoeing Turnips, &c.	Year's Gains, including Hay and Corn Harvest in.
	Price of Labour in 1790.				Price of Labour since 1804.				1810.
	s. d.	s. d.	s. d.	d.	s. d.	s. d.	s.	s. d	s. d.
East, West, and Mid Lothians	6 0	7 0	6 0	5	10 0	13 6	12	0 10	35 6
Berwick, Roxburgh, and Selkirk	6 0	7 0	9 0	5	10 0	13 6	15	0 10	35 6
Dumfries and Peebles	5 0	6 0	6 0	4	7 6	11 0	11	0 8	25 16
Galloway	5 0	6 0	7 0		8 0	11 0	11		26 4
Ayr	6 0	8 0	9 0	9	9 0	12 6	12	1 0	29 14
Lanark and Renfrew	6 0	7 0	7 0		8 6	11 6	12		27 10
Dumbarton and Stirling	6 0	7 0	7 0		8 6	11 6	11	0 10	27 10
Clackmannan and Kinross	5 0	7 0	6 6	5	8 0	11 0	10	0 9	26 4
Perth, Fife, and Forfar	5 0	7 0	7 0	5	8 0	11 0	10	0 9	26 4
Kincardine	6 0	8 0	7 6	5	10 0	12 6	10	0 10	30 10
Aberdeen, Banff, Moray, and Nairn	4 6	6 0	5 0	4	7 6	12 0	12	0 9	25 8
Argyle and Inverness	4 0	6 0	6 0	4	6 0	9 0	9	0 7	21 0
Ross, Cromarty, and Sutherland	2 6	3 6	3 0	3	5 6	8 0	6	0 6	18 16
Caithness	3 0	5 6	4 0						21 0
Orkney and Shetland	3 0	6 0	4 0						

Fiars Prices of Grain in the different Counties, for Crop 1810, *with the Value of Potatoes and Butcher Meat in different Districts of the Kingdom for the same Year.*

Names of Counties.	Wheat, per boll.	Barley, per boll.	Pease, per boll.	Oats, per boll.	Oatmeal, per peck.	Potatoes, per boll.	Beef, per pound.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Dumfries	1 17 8	1 8 0	1 0 0	0 18 0	0 1 2½		0 0 8
Fife	1 15 0	1 8 6	0 19 0	1 0 0	0 1 5	0 5 0	
Kincardine	1 11 10½	1 1 0	0 17 4½	0 17 4	0 1 3		
East Lothian	2 2 0	1 11 0¾	1 1 11½	1 2 11½	0 1 3	0 8 0	0 0 8
Berwick	1 16 0	1 5 0	1 2 8	0 19 0	0 1 3½		0 0 8
Inverness	1 15 0	1 12 0	1 8 0	1 0 0	1 1 4½		0 0 7
Moray	1 14 0	1 10 0	1 6 0	1 0 0	0 1 4½	0 8 0	0 0 7
Banff	1 12 0	1 0 0	1 0 0	0 18 6	0 1 2½		0 0 7
Aberdeen	1 12 6	0 18 8	1 0 0	0 17 0	0 1 2		0 0 7
Roxburgh, Teviot measure	2 8 4	1 14 0	1 10 0	1 3 0			
Edinburgh	1 19 0	1 7 6	1 1 0	0 18 0	0 1 3	0 10 6	0 0 8
Perth	1 14 0	1 4 1	1 3 0	0 18 6	0 1 4½		
Ayr	1 15 6	1 7 0		0 19 0	0 1 3½		
Forfar	1 17 0	1 6 0		1 1 6			
Lanark, Glasgow market	1 16 0	1 9 0	1 5 0	1 3 0	0 1 4	0 7 0	0 0 8
Stirling	1 16 6	1 12 0	1 3 0	1 2 0	0 1 4	0 12 0	0 0 8
Dumbarton	1 10 0	1 10 0		1 1 0		0 9 0	0 0 7
Ross	1 15 0	1 13 0		1 3 6	0 1 5		

A TABLE *of Prices of the Necessaries of Life in the different Counties of Scotland, in* 1792, 1793, 1794.

Counties.	Date.	Wheat, per boll.	Barley, per boll.	Oats, per boll.	Pease, per boll.	Oatmeal, per peck.	Butter, a stone.	Cheese, a stone.	Beef, a pound.	Poultry, each.	Geese, each.	Egg, a dozen
		£ s. d.	£ s. d.	s. d.	£ s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
East Lothian	1793	1 4 3	0 19 3	18 5	0 15 3	1 2			0 6	1 0	2 6	0 6
Fife	1793	1 2 0	0 15 0	13 6	0 13 9	1 0				1 0	2 0	0 6
Selkirkshire	1793	1 10 2	1 3 5	19 3	1 6 7					0 10	2 6	0 8
Roxburghshire	1792	1 4 3	1 0 4	15 1	0 16 5	1 6	13 4	5 0	0 4	0 10	2 6	
Inverness	1792	1 0 0	0 18 0	15 0	0 15 0	0 11½						
Nairn	1792		0 17 0	14 0	0 14 0	0 10½			0 3	0 7	2 0	0 2
Banff	1792	0 18 0	0 18 0	12 6		0 10	12 0	4 0	4	0 8	2 6	0 3
Clackmannan	1792	1 0 0	1 0 6	14 6	0 14 0	1 0						
Ayr	1793	1 3 0	1 3 0	17 0		1 2						
Moray	1793	1 0 0	0 18 0	16 0	0 16 0	1 1	12 0	4 0	0 4	0 9	2 9	0 2
Orkney and Shetland	1793						12 0	4 0	0 2½	0 6	1 6	0 3
Caithness	1794		0 12 0	16 0			12 6	6 0	0 4½	0 6	1 6	0 1
Ross and Cromarty	1794		0 18 0	16 0		1 2	12 0	4 0	0 2	0 6		0 2
Argyle	1794		0 19 0			1 4	12 0	6 0	0 5	0 6		
Mid Lothian	1794	1 3 0	0 19 6	18 0	0 16 0	1 2			0 6	1 2	3 0	0 7
Forfar	1794		0 16 0	15 0	0 14 0	1 0	14 0	5 4	0 4	0 10		0 5
Perth	1794	1 1 0	0 16 0	12 0	0 12 0	1 0	13 0	6 0	0 5	1 0	2 6	0 4
Peebles							10 6	6 6		1 0		0 6
Galloway	1801	1 12 0	1 8 6	15 0		1 1						
Lanark	1794	1 3 6	0 19 10	17 0	0 16 6	1 2						
Dumbarton	1793	1 1 6	0 17 4	16 0	0 16 0	1 1						
Stirling	1793	1 2 0	0 19 6	16 6	0 16 0	1 2						

Fiars Prices of Grain per Boll, &c. in different Counties of Scotland, for the Crops from 1818 *to* 1825.

		1818.	1819.	1820.	1821.	1822.	1823.	1824.
		s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
ABERDEEN	Best oats,	23 6	16 0	15 9	15 6	15 3	18 6	18 6
	Barley,	34 0	19 6	17 4	18 0	19 0	24 0	27 0
	Wheat, *Linlithgow Meas.*	34 0	29 0	27 0	26 6	20 0	25 0	24 6
ARGYLESHIRE.	Oats, per boll of 6½ Winchester bushels,	24 1	17 6	17 0	16 4	12 1	17 10	18 3
	Bear, do. do.	37 8	29 1	25 2	29 3	23 2	24 11	27 10
AYR	Barley, per boll, 8 Winchester bushels,	49 6	30 0	28 8	27 2	25 3	32 4	36 1
	Wheat, 4 Winch. bushels,	33 3	27 0	25 2	24 5	17 0	23 10	28 6
BANFF	Best oats,	22 0	14 0	14 0	14 0			
	Barley,	35 0	28 0	17 0	22 0	20 6	24 0	24 0
	Wheat,	34 0	28 0	28 0	27 6	17 6	28 8	27 0
BERWICK	Merse oats,	27 8	17 6	16 6	16 3	14 10	17 2	16 9
	Merse barley,	39 2	21 0	18 15	19 5	17 2	22 2	26 2
	Wheat,	33 1	27 4	26 0	26 7	18 2	23 9	27 10
BUTE	Oats,	26 0	18 0	19 0	20 0	15 6	19 1	21 6
	Bear,	41 2	24 0	23 0	24 0	24 0	25 0	32 8
CAITHNESS	Potatoe oats,	20 0	17 0	15 0	15 0			
	Bear,	25 0	18 0	17 0	18 0	17 0	22 6	24 0
CLACKMANNAN.	W. Kerse oats,	24 2	17 6	16 6	16 7	14 6	18 0	17 4
	Kerse barley,	41 0	22 8	20 0	18 0	20 6	27 9	31 6
	Wheat.	36 6	28 0	26 10	27 4	18 6	26 6	30 0
CROMARTY	Best oats,	25 0	18 0	16 0	16 6	16 6	18 6	19 3
	Barley,	35 9	23 4	21 4	24 0	24 0	25 9	28 9
	Wheat,	34 6	30 7	27 4	24 5	17 0	27 4	30 6
DUMBARTON	Barley,	39 11	23 10	21 2	21 3	20 2	24 0	30 8
	Oats,					14 10	17 9	18 7
	Wheat,					18 9	24 1	30 0
DUMFRIES	Potatoe oats, per bushel,	3 5½	2 9	2 6	2 7	1 10	3 3	2 8½
	Barley, do.	6 4½	3 6	2 9	3 2	3 0	3 11½	4 5½
	Wheat,	9 2	8 0	6 9	6 4	4 7	7 6	7 5
EDINBURGH	Best oats, per boll,	24 0	17 6	16 0	15 4	15 0	20 0	17 10
	Best barley,	40 0	28 0	20 0	20 0	19 6	25 7	30 0
	Best wheat,	37 6	32 6	30 6	28 0	20 6	29 0	31 11
ELGIN & MORAY.	Oats, 5 firlots per boll,	29 6	21 0	20 0	20 0	17 3	19 0	20 0
	Barley, per boll,	38 6	22 0	21 0	26 0	22 0	25 0	26 0
	Wheat, do.	35 0	24 6	29 0	26 0	17 10	28 0	29 6

TABLE—*Continued.*

		1818.		1819.		1820.		1821.		1822.		1823.		1824.	
		s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
Fife	Oats,	23	0	16	6	16	0	15	6	13	6	18	6	18	0
	Barley,	36	0	19	10	17	8	18	0	16	10	23	0	27	0
	White wheat,	35	10	29	9	27	6	27	6	19	0	26	6	30	4
Forfar	Potatoe oats,	24	10	17	6	16	7	16	5	13	10	20	5	19	8
	Barley,	38	8	19	10	17	6	18	6	14	10	25	5	29	8
	Wheat,	38	3	30	31	29	4	28	10	19	10	27	7	32	3
Haddington	First oats,	27	5	18	11	18	0	18	0	15	5	22	1	20	1
	First barley,	42	7	24	6	22	4	23	2	21	2	26	8	30	10
	First wheat,	41	4	32	11	31	9	31	8	21	8	31	2	33	3
Inverness	White oats, 5 firlots	28	0	21	0	20	0	19	0	17	0	19	6	21	0
	Barley, 4 firlots,	36	0	25	0	23	0	25	0	24	0	26	0	28	0
	Wheat, 3 firlots of county measure,									18	0	29	0	30	0
Kincardine	White oats,	21	9	15	2	13	5	13	6	12	8	18	0	15	5
	Barley,	37	9	19	0	17	4	15	6	18	8	23	0	27	10
	Wheat,	37	6	30	6	30	0	28	0	20	0	28	0	32	3
Kinross	Best white oats,	22	0	16	0	15	6	15	0	13	0	18	2	17	2
	Best bear,	32	0	18	9	16	6	17	0	16	9	22	6	27	0
	Wheat,	35	0	28	6	27	0	25	4	17	6	23	7	27	6
Kirkcudbright.	Potatoe oats, per boll of 11 Winchester bushels,	36	8	28	5	23	10	25	5	20	5	31	10	29	4
	Barley, do.	70	1	36	10	28	5	33	5	31	7	43	4	51	4
	Wheat,	93	11	79	3	63	3	60	6	47	5	80	2	80	11
Lanark	Best boll of oats,	23	0	16	10	16	7	15	1	13	8	17	11	18	0
	Best boll barley,	37	6	23	2	19	11	18	8	18	2	23	9	30	0
	Best boll wheat	38	5	27	8	27	6	27	5	19	8	28	1	31	9
Linlithgow	Great oats	23	0	17	2	16	1	15	6	13	0	17	10	16	8
	Barley,	38	1	21	9	19	0	19	4	17	2	23	2	30	0
	Wheat,	36	5	29	7	27	3	27	9	18	9	24	0	30	9
Nairnshire	Oats, 5 firlots,	28	0	22	0	21	0	19	0	16	6	20	0	19	5
	Barley, per boll,	35	6	24	0	24	0	26	0	24	6	25	6	26	0
	Wheat, do.	35	0	29	0	29	0	26	0	17	6	27	0	27	6
Orkney	Oat meal, 7¼ Dutch stone,	23	11	16	9	16	5	16	2	16	11	21	0	21	11
	Bear, do.	8	9	5	8	4	10	5	1	4	10	7	3	7	5
	In the bear pundlar.														
Peebles	Oats, first price,	22	1	15	11	16	4	14	9	12	1	18	7	16	1
	Barley, do.	38	11	20	7	20	8	19	5	18	7	28	6	28	10
	Wheat, do.	38	4	30	0	30	0	32	5	20	4	25	6	31	2
Perth	Best oats,	23	6	16	6	15	11	15	3	13	8	18	9	18	9
	Best barley,	36	0	20	6	17	6	18	0	19	0	25	4	28	6
	Best wheat,	37	10	31	0	29	8	28	0	20	6	26	7	30	0
Renfrew	Best oats,	26	0	19	4	18	3	18	8	15	9	20	0	18	5
	Best barley,	40	3	23	10	21	4	19	10	18	9	25	4	29	11
	Best wheat,	39	0	29	11	28	10	28	6	19	9	26	6	30	9
Ross-shire	First oats, 4 firlots,	25	0	18	0	16	0	16	4	16	6	18	4	19	3
	First barley,	35	9	23	4	21	4	24	0	24	0	25	9	28	9
	Wheat,	34	6	30	7	27	3	24	5	17	0	27	4	30	2
Roxburgh	Oats, Teviotdale boll,	28	10	20	10	20	0	18	6	16	2	23	4	20	7
	Barley, do.	45	9	25	0	23	0	22	0	20	0	28	11	31	9
	Wheat, do.	43	4	35	10	33	9	31	8	22	3	31	8	35	1
Selkirk	Potatoe oats, Linlith. boll,	21	4	15	9	15	10	14	5	12	8	18	11	16	2
	Barley, do.	35	4	19	8	18	7	17	9	16	8	22	0	25	0
	Wheat, do.	34	6	27	8	27	3	26	0	17	10	25	6	27	2
Stirling	Kerse oats,	23	0	17	0	16	0	16	0	13	6	18	0	17	6
	Kerse barley,	38	6	23	0	20	0	17	6	19	0	27	6	31	0
	Wheat,	36	6	27	6	27	0	27	0	18	9	26	6	30	6
Sutherland	Best oats,	27	0	21	0	19	0	20	0	18	0	20	6	20	0
	Barley, 4 firlots,	36	0	24	0	21	0	23	0	23	6	25	0	28	0
	Wheat, 4 bushels,							28	0					31	0
Wigton	Barley, Galloway boll,	69	0	40	0	32	0	33	0	33	0	44	6	57	3
	Best oats,	40	0	30	0	25	0	26	0	21	6	31	6	31	6
	Wheat, 8 Winch. bushels,	68	0	52	0	44	0	48	0	32	0	51	4	57	6

N.B.—An English *quarter* of wheat and pease is equal to 1 boll 3 firlots 3 pecks and [illegible]ths of a peck Scots measure. An English quarter of barley and oats is 1 boll 1 firlot 1¼ peck.

Statistics, Agriculture.

In order to convert the County Bolls into Linlithgow Bolls, the following Table will be useful.

100 *Bolls of*	*Linlithgow Boll.* Wheat. Bolls.	Firl.	Pts.	Barley. Bolls.	Firl.	Pts.	100 *Bolls of*	*Linlithgow Boll.* Wheat. Bolls.	Firl.	Pts	Barley. Bolls.	Firl.	Pts.
Linlithgow,…………	100	0	0	100	0	0	Kincardine,…………	112	3	76	106	1	80
Aberdeen,…………	122	1	41	109	2	70	Kinross,…………	102	2	58	103	0	9
Argyle, *Inverary*,……	116	1	0	107	1	3	Kirkcudbright,…… ..	162	1	60	184	1	93
Argyle, *Campbellton*, ..				128	2	83	Lanark, Glasgow, and Lower Ward,………	105	1	27	103	1	40
Ayr,…………	97	3	46	134	0	67							
Banff,…………	105	1	64	105	0	41	Lanark, Upper Ward,..	100	0	0	103	0	90
Berwick,…………	152	3	76	104	3	35	Nairne,…………	121	3	90	111	1	93
Bute,…………	130	3	92	134	2	70	Peebles,…………	107	0	59	104	1	83
Caithness,…………				106	1	0	Perth,…………	102	3	94	104	0	65
Dumbarton,…………	116	2	52	106	2	38	Renfrew,…………	100	0	0	106	1	0
Dumfries,…………	302	0	73	268	1	35	Ross,…………	112	3	76	103	0	90
Edinburgh,…………	101	3	5	101	2	43	Roxburgh,…………	129	1	64	133	0	25
Elgin,…………	106	3	6	105	1	2	Selkirk,…………	129	3	11	126	0	3
Fife,…………	105	3	11	103	0	90	Stirling,…………	108	0	94	107	1	3
Forfar,…………	103	2	11	103	2	51	Sutherland,… ………	117	2	58	110	2	57
Haddington,…………	102	3	76	103	0	9	Wigton,…………	195	2	92	201	1	1
Inverness,…………	114	1	82	109	3	14							

TABLE A.

State of Landed Property in Scotland.

Counties.	Valuation as returned by the Collectors of the Land-Tax.	Number of Estates exceeding L.2000 Scots of Valuation.	Number of Estates from L.2000 to L.500 Scots of Valuation.	Number of Estates under L.500 Scots of Valuation.	Total Number of Estates.	Total Valued Rent belonging to Corporations.	Number of Estates belonging to Corporations, &c.	Estimated Amount of Valued Rent of Entailed Property Scots Money.
Aberdeen,	£235,665 8 11	28	88	114	230	£9100 7 2	1	£90,000 0 0
Ayr,	191,605 8 7	20	51	200	271	Trifling.		79,035 0 0
Argyle,	149,595 10 0	17	43	131	191	5 14 6	1	49,898 0 0
Banff,	79,200 0 0	9	17	14	40	None.		42,762 14 10
Berwick,	178,366 8 6$\frac{7}{12}$	22	59	152	233	905 17 0	2	59,788 2 0
Bute,	15,042 13 10	2	2	6	10	Not valued.	1	5,010 0 0
Caithness,	37,256 2 10	5	11	14	30	None.		13,631 0 0
Clackmannan,	26,482 10 10	4	6	22	32	952 16 9		9,834 11 5
Cromarty,	12,897 2 7$\frac{8}{12}$	3	2	5	10	None.		7,196 8 4
Dumfries,	158,502 10 0	10	30	405	445	822 0 0	3	86,709 3 4
Dumbarton,	33,327 19 0	1	19	136	156	80 0 0	1	11,109 6 0
Edinburgh,	191,054 2 9	10	92	569	661	6752 18 0	19	33,683 0 0
Elgin,	65,603 0 5	7	18	23	38	None.		24,580 0 0
Fife,	363,192 3 7$\frac{2}{12}$	45	102	491	638	500 0 0	29	123,664 0 0
Forfar,	171,339 16 8	16	59	191	266	4251 6 0	19	57,079 5 3
Haddington,	168,873 10 8	23	29	133	185	1305 14 3		56,257 3 0
Inverness,	73,188 9 0	12	18	57	77	Trifling.	1	24,864 5 5¼
Kincardine,	74,921 1 4	11	29	46	86	410 3 10	3	18,730 0 0
Kinross,	20,250 4 3⅓		7	161	168	25 0 0	1	6,750 1 0
Kirkcudbright,	114,597 2 3$\frac{11}{12}$	7	40	354	401	576 6 8	5	33,26 16 6¼
Lanark,	162,131 14 6	9	50	1096	1155	8878 1 6	13	36,141 11 6
Linlithgow,	75,018 10 6¼	8	22	122	150	365 13 0	11	34,043 4 0
Nairn,	15,162 10 11	3	3	9	15	None.		2,506 3 0
Orkney,	57,786 0 4$\frac{1}{6}$	4	11	195	210	Not valued.	1	2,736 6 1
Peebles,	51,937 13 10	6	21	54	81	198 9 0	1	33,114 0 0
Perth,	339,892 6 9	39	95	621	755	2009 18 8	11	28,019 11 6
Renfrew,	69,172 1 0	6	22	300	328	1237 6 8	2	29,841 0 7
Ross,	75,043 10 3	10	25	50	85	417 19 6		22,466 2 0
Roxburgh,	314,663 6 4	33	55	261	349	3094 0 0	5	104,887 4 0
Selkirk,	80,307 15 6	9	20	15	44	1053 3 4	1	32,661 0 0
Stirling,	108,509 3 3$\frac{1}{12}$	9	29	109	147	1353 4 2		25,007 0 0
Sutherland,	26,093 9 9	2	3	8	13	None.		14,427 17 11
Wigton,	67,641 17 0	6	16	83	105	92 0 0	2	44,000 0 0
	3,804,221 0 0	396	1094	6147	7595	44,388 0 0	143	1,213,159 17 9

Table B.

Account of the Gross Amount of Rent, or Annual Value of Lands, including Mines, Quarries, Collieries, Fishings, &c. and of Houses, in the several Counties of Scotland, as Assessed under the Property Tax for the year ending 5th April 1811.

Counties including their respective Towns and Burghs.	Gross Amount of Rent of Lands.			Gross Amount of Rent of Houses.		
Aberdeen,	£233,826	19	10	£66,557	9	9
Argyle,	192,073	14	2	5,208	18	10
Ayr,	336,471	10	0	22,823	0	0
Banff,	79,396	3	4	5,514	2	0
Berwick,	231,973	2	7	8,152	17	6
Bute,	18,591	9	2	2,310	1	7
Caithness,	30,926	1	9	1,698	7	6
Clackmannan,	32,047	12	0	2,827	5	0
Cromarty,	10,860	2	8	480	0	0
Dumfries,	246,001	12	6	16,787	0	0
Dumbarton,	56,972	15	0	5,791	15	0
Edinburgh,	277,827	19	1	400.064	4	6
Elgin,	62,312	9	6	2,753	14	6
Fife,	335,290	14	6	38,756	1	6
Forfar,	260,196	15	0	64,108	0	0
Haddington,	180.654	5	9	6,870	15	2
Inverness,	195,843	15	0	9,235	2	0
Kincardine,	159,895	19	2	9,235	2	0
Kinross,	83,487	11	8	3,549	16	7
Kirkcudbright,	22,752	10	0	1,623	5	0
Lanark,	298,019	3	1	286,071	13	5
Linlithgow,	82,947	2	0	5,798	8	0
Nairn,	11,725	14	0	216	0	0
Orkney,	9.495	3	6	2,138	14	6
Peebles,	57,382	0	0	2,568	0	0
Perth,	460,738	13	11	36,697	19	7
Renfrew,	127,068	15	9	106,238	7	2
Ross,	91,089	18	8	2,798	1	4
Roxburgh,	230.663	9	9	11,508	6	3
Selkirk,	39,775	10	0	834	0	0
Shetland,	6,741	6	0	1,408	0	0
Stirling,	177,498	14	0	25,370	7	8
Sutherland,	28,457	9	0	247	0	0
Wigton,	123,836	10	10	3,595	10	0
Lands, &c.	4,792,842	13	2	1,158,777	7	4
Houses,	1,158,777	7	4			
	5,951,620	0	6			

Extent and Value of the Mineral Productions of Scotland in 1814.

COAL.

Extent of the coal-field of Scotland in acres	600,600
Annual consumption in acres	172
Quantity consumed annually in tons	2,500,000
Value of the coal annually consumed, at 6s. 8d per ton,	£833,333
Expence of labour 5s. 10d. per ton	729,166
Rent to the proprietor 10d. per ton	104,060

LIME.

Quantity of lime annually made in Scotland	3,000,000
Quantity in Winchester bushels, at 4s. per bushel	12,000,000
Value at 2s. 6d. per boll	375,000
Extent of land annually dressed with lime	100,000

IRON.

Number of blast furnaces	21
Quantity annually produced in tons	32,760
Value at £7 per ton	£229,320
Number of persons employed	7650

LEAD.

Agriculture.

Number of tons of lead produced annually	65,000
Annual value at £2 per ton	£130,000

Annual Value of the Mineral Productions of Scotland.[*]

Coal	£833,333
Lime	375,000
Iron	229,320
Lead	130,000
Miscellaneous articles,	30,000
	£1,597,653

CHAP. IV. COMMERCE AND MANUFACTURES.

Commerce and Manufactures.

FROM the peculiar circumstances in which many of the subjects of this department of our essay exist in Scotland, and the interest especially attached from local circumstances to those petty and remote ones which possess the least conspicuity, it will be convenient to treat a portion of this subject in a geographical order, such as we have adopted for the general description of the country. It is not a matter of slight interest to know those branches of industry by which the comforts of our remote population are so materially affected, to see how they at present stand, what failures have occurred in attempts to establish them and their causes, and what prospects there are of increasing them with advantage, at least to the local if not to the general community. As we cannot well keep the two different circumstances of commerce and manufactures separate, where there is so little of either, without encumbering ourselves with divisions, we shall, in treating of the remoter districts, unite them. Under this head also, we shall, as far as is necessary, notice some of our principal roads and harbours, as far as they are peculiarly connected with the objects for which they were undertaken.

Shetland and Orkney.

Shetland and Orkney.

The principal manufactures of Shetland must be considered to consist in its ling fishery. This finds employment during its short summer for the chief part of the active population. This fishery is carried on by means of long lines, about thirty miles at sea, and is attended with considerable hazards, though, from the expertness of the boatmen, accidents are extremely rare. The fishery itself is in the hands of the principal gentlemen or landholders, who are also the manufacturers and merchants; and the men do not generally receive wages, but pay a portion of their rents in this labour, which thus constitutes a species of servitude. Whatever opinion may be entertained generally, about this system, it is here not merely convenient but necessary, as there is no surplus produce on these petty farms from which a rent in money could be paid. This ling is nearly all exported to Spain; but the demand is not sufficient to employ all the labour which could be applied to this object.

The manufacture of kelp is also pursued in Shetland, and on the same plan as the fisheries, the market being Leith. In former times there was a considerable manufacture of knitted stockings, carried on chiefly by the women during their other avocations or moments of leisure. The loss, or rather great diminution of this, is much to be regretted, as it was a source of considerable profit, without cost, as it may be fairly stated, since it was the occupation of labour which had no ten miles, and rising immediately from the sea. It is an entire quarry, and with scarcely the labour of working, might be loaded of any size from the rock into the ship. Here, were it necessary, columns might also be wrought of any length, and shipped. Excellent freestone may also be procured on the western shore of Mull, and in Inch Kenneth.

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[*] The chromate of iron, discovered by Dr. Hibbert in Shetland, and now exported in large quantities, is not included in this enumeration.

But it is in granite that Mull is particulary rich, while nothing can exceed the commodiousness of the situation for quarrying and shipping. This tract of rock lies at the mouth of Loch Scriden on the Ross, which is formed of it; and this loch offers secure harbours in abundance. The quality resembles that of the Egyptian, being of a high red colour, and a large grain. Having been used in the ancient buildings of Iona, its aspect is generally known. It is perhaps even more valuable for its solidity of dimension and for its forms, easily wrought, than for its colour. As it is disposed naturally in large blocks, and in thin and flat masses, it is easily split into the shapes required by architecture, and is of such dimensions and continuity, that it would afford shafts of columns fifty feet in length, emulating those of ancient Egypt.

Of many other granites, we shall content ourselves with indicating only one more, on account of its peculiar advantages. This is found on the east coast of Harris, near Loch Trolamarig, consisting of immense blocks, almost already squared to the mason's hand, of a very free grain and beautiful colour, and lying so loose on shelving rocks by the sea shore, that it might be shipped directly into a raft merely by a lever and rollers. Were large monumental stones required, these would scarcely cost more than the freight.

It would be endless to point out the various and commodious quarries of all this shore; but Jura deserves notice, not only for the same facilities, but for the beauty of its white quartz rock. This stone is not only preferable to granite in point of durability, being absolutely indestructible, whether above water or below it, but excels the finest sandstone in beauty of colour and texture. At the same time, it is offered by nature in blocks which are often ready squared to the mason's hand, or which might be rendered square by a few blows of the hammer. That such a material has been utterly neglected by architects, is the result of habit and of ignorance respecting the existence of a rock which has only lately been pointed out even to geologists.

Isla might easily furnish roofing slate were it required, and it now possesses a valuable variety of this substance hitherto entirely neglected, and well deserving the notice of architects and masons. This slate rises without any labour, in flags so large that they will serve alone for the walls of cottages or out-buildings, requiring only to be set on their edges, and combining therefore cheapness with eternal durability and safety from leakage. A still more valuable variety may be procured with great facility in posts and beams, so even as not to require a tool; or, if necessary, capable of being rendered absolutely square by a very little labour of the adze. The beams are often from twelve to fifteen feet long or more, and not above three or four inches square; so that they would serve for joists and rafters were it necessary to guard against fire, while, when of a less size, they answer a great variety of useful purposes in rural architecture.

Of limestone, Lismore is an entire quarry, and it furnishes much of the neighbouring coast, being generally burnt on the spot. Many other practicable quarries are superseded by the lime of the east coast; but Broadford also, in Sky, possesses an extensive manufacture of burnt lime, for which there is a large demand. Here also there are endless quarries of marble of various qualities, and of ornamental appearance, well adapted for interior architecture. Among these there are considerable rocks of pure white marble, the best and the most considerable yet discovered in the British dominions. The grain is extremely compact and fine, and well adapted to the smaller works of statuaries. The quarries have been opened, but no attempts were ever made towards a sale. In the Garveloch isles also there are inexhaustible quarries, and not less convenient. These are of still more various colours, being whitish, yellow, and pink, veined with red; while there are also large beds of breccia, nearly resembling many of the most highly prized Italian antique breccias, and not less ornamental. As yet this rock is unknown. While on this subject, we may also mention the marbles of Assynt in Sutherland, once wrought, but abandoned; with others on the shores of Loch Eribol and Diurness bay, which might easily become articles of commerce were it the fashion to employ our own produce.

Of the in-door, or domestic manufactures of the Highlands and islands, we may enumerate hemp, flax, and wool, as the sole materials. Yet little or nothing is made for exportation, the whole, nearly, being for objects of domestic consumption, or for the very limited market at their own doors.

It has been a frequent and favourite speculation, that regular manufactories might be established in the Highlands with advantage to the country, and that this might tend to check that emigration so long held in dread. Thus it was supposed that the fishing towns might also become manufacturing ones, and hence find occupation for an unemployed people. But this is to forget, that capital does not leave its established and habitual seats without strong inducements, and that no inducement could be held out to it to move from the places of established industry and acquired mechanical skill, to those noted for the want of both, and to a people averse to minute attentions and steady exertion. Nor does the natural produce of the Highlands of any kind hold out temptations of this nature, when it is so much more easily transported in the rude state to the markets, where, after all, it must be consumed or exported.

Of the manufactures purely domestic, flax is the principal, being spun and woven into coarse but useful linens. A small quantity of wool is also wrought in the same manner, and for similar purposes, being frequently dyed by the native vegetables, and with considerable dexterity. A very little hemp is wrought into fishing lines.

Instead of establishing capital and regular manufactories, where labour thus appropriated must be paid, and where the capitalist would find no compensation for surrendering his machinery, and abandoning his connections and workmen, it appears to us that it would be the best and most useful policy, at least for the people, to encourage those domestic ones, which may be carried on when the weather confines the agriculturist to the house, or when he has no employment on his farm; a state of things which occupies half the year. Here all the labour thus employed would be clear gain; and thus also costing nothing, the produce might even compete in the market with that of capital and machinery, and with superiority of mechanical dexterity and habits. This is the labour which, if it came into the market, must receive a market price, and would therefore destroy itself; and hence it is, that while the manufacture, directed and paid by a capitalist in the Highlands, must fail, that which was carried on by each man or family on its own account could not but thrive.

For this reason, it would be good policy to increase the culture of hemp, for which the demand is constant; as the making of nets and lines would find employment for the farmer and fisherman's idle hours. Thus also the cultivation of flax might be extended; nor does there seem any reason but the want of attempts and perseverance, why the Highland families, now idle and poor, should not add to their wealth and industry by adopting the linen manufacture on the same plan as it is conducted on many parts of the continent of Europe. That the same principle might be extended to coarse woollens, is too obvious to require notice.

It is part of this subject, as well as of the concerns of agriculture, to point out the advantages which have been derived from the construction of new roads and bridges in the Highlands and islands, and from the improvements in the communication by ferries, packets, and posts.

We already noticed this as to the Long island; but ought here to add, that North Uist contains an excellent road, traversing the island, made at the expence of its proprietor, and that there is also a considerable extent of good road in Lewis, though much more is yet wanting. These are always important, were it merely on account of the commerce in cattle, which forms so large a portion of the trade of all the Highlands; and not less important in this view are the improvements in the ferries, whether as it relates to the piers, landing places, or to the boats themselves.

Sky has now a post twice in the week, and nothing is wanting either with respect to its roads or ferries, which cannot be exceeded for goodness and convenience. In these conveniences Raasay also in some measure partakes. Mull is a contrast in every sense, having but one or two short roads, and being almost impassable everywhere else, while its ferry is as inconvenient as a ferry can well be, since it traverses the even more trackless island of Kerrera, and this requires also a double embarkation. The smaller islands Rum, Canna, Tirey, Coll, and others, want every convenience, being without roads, ferries, or posts; and Jura is equally trackless and impassable, though benefiting by the packet to Isla. Here every thing is as commodious as could well be desired, as this island is sufficiently intersected by excellent roads.

On the western mainland, though the country cannot be traversed longitudinally, a communication with the central roads of Scotland, sufficiently convenient for most parts, has been made by various transverse roads terminating on the sea shore. The points where these greater roads meet it, are Oban, Airdnamurchan, Arasaik, Loch Hourn, and Loch Alsh; and others less perfect lead to Pol Ewe, Loch Carron, and Ullapool. The west of Sutherland is still deficient in this respect; but a road to Tongue now affords a ready avenue to the north coast. Of the central lines we need here take no notice; and shall therefore proceed to consider the more important and leading trade and manufactures of Scotland.

Statistics.

Commerce and Manufactures.

The manufactures carried on in Scotland, may be classed under two distinct heads:

1. The primary or most important, which require much machinery, and employ great numbers of people; and 2. The secondary, which in both these respects are inferior.

The first head comprehends, 1. The woollen; 2. The linen; and 3. The cotton.

The second (including some of the chief branches of the mechanical arts,) contains a variety of articles: as 1. Silk; 2. Calico-printing, &c.; 3. Hats; 4. Paper; 5. Iron; 6. Copper, lead, and tin; 7. Wood; 8. Tanning; 9. Breweries and distilleries; 10. Sugar refining; 11. Pottery; 12. Glass; 13. Soap, candles, and starch; 14. Culinary salt; 15. Tobacco and snuff; 16. Combs and spoons; 17. Coal, lime, and marble, as connected with manufactures; and 18. A number of miscellaneous particulars.

1. *Woollen.*

Woollen.

This species of manufacture, the most ancient known in Scotland, consists of four principal divisions: 1. Spinning, or the conversion of the raw material into yarn; 2. Weaving, or the manufacture of yarn into cloth, blankets, carpets, &c.; 3. Knitting, or the manufacture of yarn into stockings, gloves, pantaloons, &c.; and 4. Felting, or the making of woollen hats.

Spinning.

1. *Spinning.*—Some attempts were made, before the two crowns were united, to establish the woollen manufacture in Scotland on a regular footing; and experienced workmen were accordingly brought for that purpose from different parts of Europe. But these attempts failed, and the trade gradually reverted to its former narrow limits, when the woollen cloths made in Scotland were chiefly manufactured by the extra labour of those who were employed in husbandry. The females, especially in winter, were occupied in carding and spinning the wool. The yarn thus produced was either given to a country weaver, to be woven into cloth for family use, or sold to such dealers as frequented fairs, where the surplus of both cloth and yarn was exposed to sale. This mode of manufacturing woollen yarn and cloth is not yet entirely abandoned, although now principally confined to the Highlands and poorer districts of the country.

Before the introduction of machinery for spinning wool, the process was performed in two ways: 1. By the large wheel of one spindle driven by the hand; and 2. By the small wheel of one or two spindles driven by the foot, after the wool had been prepared by the hand-card, or combed. Wool-combing was once a considerable branch of this manufacture; but it is now almost entirely superseded by carding machines.

Mr. Baird, of Aberdeen, was certainly among the first who introduced machinery in the manufacture of wool in Scotland. In 1789, he brought from Rochdale two carding engines, and four spinning-jennies, with the other necessary apparatus. That part of the machinery which required the power of water was erected at Stoneywood, on the river Don; but the jennies with looms, &c. were fixed at Aberdeen. About 600 lbs. of wool were manufactured weekly until the year 1796, when the machinery was increased to twice the extent. The preparation of wool by hand was generally laid aside, and several other mills were erected in Aberdeenshire; so that in 1799, about 4000 lbs. were weekly manufactured by eighteen engines. So rapid indeed has been the increase of this manufacture, that mills have been erected, not only in the different parts of Aberdeenshire, but at Elgin, Forres, Inverness, Cromarty, in Caithness, and in some of the southern and western counties of Scotland. But the most considerable work of this kind in Scotland, is that of

Messrs. Hadden and Company at Aberdeen, which extends to twenty machines, wrought by two powerful steam engines.

Commerce and manufactures.

Weaving.

2. *Weaving.*—In Scotland, the manufacture of woollen cloth was formerly confined to coarse fabrics, every attempt to produce a fine quality on equal terms with the English having failed; and as far back as 150 years ago, a species of cloth termed fingrams, was made at Aberdeen for the foreign market; but the general manufacture of the country were seys and serges for home consumption. Since the introduction of machinery, however, superfine broad cloths, equal to the best made in England, are manufactured in Scotland, particularly at Cothal Mills, in the parish of Fintray; at Kinmundy, in the parish of Longside; and at Peterhead, in Aberdeenshire, the greater part of which is sent to the London market. But the prevailing manufacture still consists of coarse articles, such as narrow cloths, duffles, plaidings, blanketings, checks, flannels, seys, and serges, either for home sale or for exportation. These articles are chiefly made in the shires of Aberdeen, Inverness, Argyle, Perth, the Lothians, Ayr, Peebles, Selkirk, and Roxburgh. Tartans of various kinds are principally fabricated in the counties of Stirling, Argyle, and Inverness; and coarse cloths and blankets for family use are made in most parts of Scotland. But this branch of the woollen manufacture is much limited, owing to the preference given to English blankets, which, from their lighter texture, afford a more comfortable covering.

Carpets.

Carpets.—This branch of the woollen manufacture is carried on to a considerable extent, but principally confined to coarse sorts; for those made in imitation of Turkey or Wilton carpets are not attempted. This manufacture is conducted chiefly at Aberdeen, Kilmarnock, Stewarton, Stirling, Bannockburn, Jedburgh, and Hawick. A few are also made at Glasgow, Leith, and in the county of Haddington, and a manufactory of Brussels carpets has lately been established in Edinburgh. The spinning, dying, and weaving departments, are carried on at the respective manufactories. There are between 400 and 500 weavers of this article in Scotland, about 130 of whom are in Kilmarnock alone. A man weaves about six yards per day, and receives from 3½d. to 4½d. per yard. The selling prices run from 2s. 9d. to 3s. 9d. per yard. A considerable quantity of carpeting was sent to the United States; but since the commencement of the war, the exportation of that article has declined, and the principal markets are now London and Dublin, with Edinburgh, and the other towns of Scotland.

Knitting.

3. *Knitting.*—The knitting of stockings forms, in many parts of Scotland, a domestic manufacture. It was formerly carried on to a considerable extent in Shetland, as we formerly remarked, and more particularly in Aberdeenshire, whence great quantities of stockings were exported to America, Holland, the Netherlands, and the north of Germany. The French revolutionary war almost ruined this trade to the European continent. But the hosiery manufacture has been revived in a different and improved state, in consequence of the introduction of machinery for spinning the yarn; and it is now carried on, including all its branches, to a greater extent than at any former period.

Stockings.

Stockings.—Stockings are either knit by wires, or wrought by frames. The former kind are preferred to the latter, as being more durable. The statute Geo. I. c. 13, ordains that all stockings shall be made of three threads; but this regulation is not strictly adhered to, particularly in frame-work; and stockings are frequently made of only two, and even of one thread. The latter are denominated "yarn hose." The manufacturers in the northern districts, employ women chiefly to knit their stockings at a certain rate per pair; and in general the quality is coarse, the price of the article when finished being only from ten shillings to forty shillings per dozen. The making of breeches and pantaloon pieces has become a considerable and increasing branch of the hosiery trade.

Lamb-wool Hosiery.—This branch of the stocking manufacture was introduced only about thirty years ago. The yarn is made of the short wool of lambs, carded by machinery, and spun on wheels resembling the common cotton-jennies. It is soft and oozy, which constitutes its principal property; as being elastic and spongy, it forms an agreeable and warm covering. This manufacture is carried on chiefly in the southern counties, about Hawick, Jedburgh, Galashiels, Selkirk, Peebles, and Dumfries. At these places, the scribbling and carding machines are driven by water; but the roving and spinning processes are performed by jennies wrought by hand. This branch is also carried on to a considerable extent at Glasgow and Edinburgh, and in their vicinity. The power of steam is applied to drive the machinery; and not only the teazers and cards, but the jennies, reels, and twisting machines, are moved by this power. The number of frames at work on lamb-wool stockings, breeches, and pantaloon pieces in the southern districts of Scotland, is from 700 to 750. Those in and near Edinburgh amount to about 150; and at Glasgow, and the adjacent towns and villages, to about 200. After the lamb-wool hosiery is woven, it generally receives a small degree of wauking and scouring; and the undyed articles are subjected to the fumigation of burning sulphur, which, by destroying the yellow tinge of the wool, makes the white much more pure.

4. *Felting.*—In Scotland bonnets were formerly much used, not only in the Highlands, but also by the lower classes in other parts of the kingdom; and they are still considered as a most essential part of the Highland military garb. But the refinement of the times has found a substitute in hats, which, even among the poorer people, have almost everywhere supplanted bonnets. Besides the hats made for home consumption, considerable quantities of a coarse quality for negroes, &c. are exported to the West Indies.

The above-mentioned manufactures are the principal branches of the woollen trade carried on in Scotland. Considerable quantities of long or combing wool are imported. In regard to the short or clothing wool, the manufactures above described do not nearly exhaust the raw materials produced in the country; and great quantities of that description of wool are purchased by agents for the manufactories in England.

2. *Linen.*

The manufactures of flax and hemp are deemed objects of great national importance, and have long received the fostering protection of government. "An act for better regulation of the linen and hempen manufactures of that part of Great Britain called Scotland," was passed in 1727. In consequence of that statute, a board of trustees was established in Edinburgh, "for overseeing, directing, and better improving the said linen and hempen manufactures," on which extensive powers were conferred. This Board has since continued in constant activity, and regulated the trade in all its branches, from the sowing of the flax-seed to the measuring and finishing of the bleached cloth.

The linen and hempen manufactures are divided into various branches, which are carried on either separately or in combination. The linen branches are as follows: 1. Spinning; 2. Weaving the yarn into a great variety of fabrics; and 3. Thread-making, both coloured and white, or the twisting of yarn into a slender twine, for the purpose of sewing, making fringes, net-work, &c. The subsidiary operations required to complete these branches, are also distinct operations; such as flax-dressing or heckling, bleaching and dying, callandering, lapping, &c.

1. *Spinning.*—In Scotland anciently yarn was spun by the distaff, or rock and spindle. This method was superseded by the introduction of the common wheel, which at first had only one spindle; but, about sixty years ago, it was improved by the addition of another. This wheel is to be found in almost every family in Scotland. The higher classes of females formerly amused themselves with this occupation; and spinning was then considered to be a profitable employment to the females of the lower class, though much less so at the rate now usually given. A third mode of spinning has lately been invented; and machinery on the principle of cotton mills is now much employed, especially for spinning the coarser kinds of grains, or such as are fit for dowlas, canvass, and threads.

1. *Hand-spinning, or that by the common Wheel.*

This branch is carried to great extent in the shires of Perth, Angus, Mearns, Aberdeen, the northern counties, and in Orkney. The flax, after being dressed, is given out by agents in the country to the females, who spin it at a certain rate per spindle. The yarn is either manufactured in the neighbouring towns and villages into cloth and threads, or it is sent to the different markets in the south of Scotland, and also to those in England for a similar purpose. The county of Aberdeen is the chief seat of this branch, which rose proportionally as the stocking manufacture declined.

Mill-spinning, or Spinning by Machinery.

This mode was introduced in the year 1790, the first flax mill in Scotland having been then erected at Inverbervie, in Kincardineshire. It has now become an important branch of the linen manufacture, and employs an immense capital. These mills are general in Aberdeenshire and the Mearns, and the shires of Fife and Angus, (where forty-four mills are employed); there are several also in the more southern counties. But the most extensive in Britain is situated at Grandholme, on the Don, about two miles from Aberdeen. The whole extent of the spinning machinery in Scotland may be estimated at 30,000 spindles; and supposing these to be in full employment, they will spin 2,600,000 spindles of yarn annually; and calculating the same number to be spun by the hand-wheel, the total amount of this manufacture in Scotland will be about 5,200,000 spindles.

Although the yarn spun by machinery is strong and even, yet it cannot be made of so fine a quality as to suit the lighter fabrics of the linen manufacture, and therefore the use of the common wheel must be continued. Machinery, however, possesses several advantages over hand-spinning. It is driven by water or steam, and the whole manufactory may be contained in one house, where the dressing and spinning of the flax, with the weaving or twisting of the yarn, may at the same time be conducted. All the operations required to bring the raw material to a finished state, are thus placed under the immediate inspection of the master, who besides receives a quicker return for the capital invested, than when he resorts to hand-spinning, which is both more tedious and expensive. Not only the dressed flax, but the tow or refuse, and also hemp and hempen tow, are spun by machinery, adapted respectively to the nature of the different materials. So various and important, indeed, is the power of mechanism, that the invention of mills may be deemed a new era in the linen manufacture.

Commerce and manufactures.

The yarn produced by the spinning mills is partly manufactured into threads, shirtings, ticks, checks, sail-cloth, Osnaburghs, &c. in Scotland, and partly sent to the markets of England for similar purposes. It is made up in small bundles, denominated spindles, regulated as to length and number of threads by act of parliament. Each spindle contains four hanks, and each hank twelve cuts of one hundred and twenty threads, ninety inches in length.

Linen cloth.

2. *Linen Cloth.*—Since the year 1727, the progress and extent of the linen cloth manufacture in Scotland may be known with tolerable accuracy by the returns of the stamp-masters to the board of trustees. It appears that in 1728, there were stamped 2,183,978 yards, value £103,312, 9s. 8d. Sterling; and that the trade has gradually increased since that period, the quantity stamped in 1812 being 18,975,862½ yards, amounting to £1,020,493, 11s. 2¾d. Sterling. It is also evident from the returns, that the average value of the cloth, during that period, has not varied more than fourpence Sterling per yard, being, from the years 1734 to 1747, and also in 1793, under ninepence; and since 1793, the average price has very seldom exceeded one shilling per yard. But the cause of apparent equality of price is, that except by private families, very little fine cloth is now manufactured, having been supplanted by the substitution of cotton goods, and the importation of Irish cloth. There is, however, still a quantity made by private families for domestic use; but as the law does not require it to be stamped, it is not included in the reports of the officers of the board. There is also an inconsiderable quantity made for sale in the northern and western counties. The manufacture of middling qualities of linen cloth has also greatly decreased. At Aberdeen, for instance, it appears that 38,780¾ yards of bleached cloth, value two shillings per yard, were stamped in the month of December, 1811; but in October the following year, 11,619 yards only were stamped; and since that time the quantity has considerably diminished. When Dutch flax, however, can again be obtained, this manufacture will revive.

The linen manufacture of Scotland is, therefore, at present, nearly confined to coarse articles, such as plain sheetings, Osnaburghs, bagging, and canvass. The three first are principally exported to the West Indies, and to America, and the last is a war article, of which the royal navy requires a great quantity.

1. Sheetings, Osnaburghs, bagging, canvass, are chiefly made in Forfarshire. The manufactures in this district had extended to upwards of eleven and a half millions of yards in the year 1812, worth more than £540,000 Sterling; but at the same time of such coarse fabrics, as to average something less than one shilling per yard.

2. The same species of goods is also made in Fife;

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and in 1812, the quantity of cloth stamped of every description exceeded four and a half millions of yards, averaging 14½d. per yard, and amounting in value to £280,000 Sterling. In that county, a considerable quantity of broad linens, ticks, and checks, are made, which are stated at double the price of the coarse fabrics of Forfarshire; and also diaper, estimated at from 2s. 6d. to 9 shillings the yard. Of checks, 650,000 yards, amounting to £35,000; of ticks, 540,000 yards, amounting to £46,000; besides 42,000 yards of diaper, worth nearly £6000 Sterling. The chief seats of these manufactures are Kirkaldy, Dysart, Leslie, and Dunfermline; and this last place is particularly celebrated for its fine diaper. In Perthshire, a million and a half of yards were stamped, worth about £70,000, of which 25,106 yards were diaper. In the counties of Aberdeen and Mid-Lothian, about half a million of yards, worth nearly £60,000 Sterling, were stamped, of which 6496 yards were diaper, manufactured in the latter county.

3. The linen cloth manufacture, in the northern and western districts of Scotland, consists chiefly of fine articles. In the shires of Banff, Moray, Inverness, Caithness, and in the Orkney and Shetland Islands, the price per yard, when bleached, may be stated at from 1s. 6d. to 3s. 6d. the greater proportion being fine qualities. In the counties of Dumfries, Ayr, Dumbarton, Lanark, Renfrew, and Argyle, the price is from 2s. to 4s. 6d. per yard. About 5000 yards of lawn were stamped at Glasgow, value 4s. 6d. per yard; but the amount of the manufacture in the northern and western districts, stamped by the officers of the board of trustees, will not altogether exceed in value £95,000 Sterling for the year 1812.

The following table will show the state of the linen trade in Scotland from 1812 to 1823. Since 1822 the stamping of linen has been discontinued, so that we are unable to bring the table down to the present year.

Account of the Quantity and Value of the Linen Cloth Manufactured and Stamped for Sale in Scotland for ten years preceding the year 1823.

Years.	Yards.	£ s. d.	Average price per yard.
1813	19,799,146½	£977,382 1 7½	at 11$\frac{1}{12}$ds.
1814	26,126,620¼	1,253,574 16 10½	— 11$\frac{6}{12}$
1815	32,056,015¼	1,403,766 15 2	— 10$\frac{6}{12}$
1816	26,112,045½	1,026,674 1 11¾	— 9$\frac{5}{12}$
1817	28,784,967¼	1,092,689 2 8¼	— 9$\frac{1}{12}$
1818	31,283,100½	1,253,528 8 0½	— 9$\frac{7}{12}$
1819	29,334,428¼	1,157,923 4 11	— 9$\frac{5}{12}$
1820	26,259,011¼	1,038,708 18 5¼	— 9$\frac{5}{12}$
1821	30,473,461¼	1,232,038 15 4¾	— 9$\frac{8}{12}$
1822	36,268,530½	1,396,295 19 11½	— 9$\frac{2}{12}$

Edinburgh, 23d December 1825.—Extracted from the Linen Register by G. THOMSON.

It has been calculated that 76,000 persons are engaged in the manufacture of linen and hemp in Scotland, and that the total value of the manufactured article is £775,000. The average amount of the bounties paid on the exportation of linen goods manufactured in Scotland is about £46,000 per annum.

Canvass.

Canvass.—The manufacture of canvass, or sailcloth, has been long established in Scotland; and for many years the royal navy has been chiefly supplied from that part of the kingdom. It is generally made of flax yarn, warp, (double,) and hemp yarn woof, (single.) This is boiled with potashes, but not bleached. The whole supply of the navy, private shipping, and for exportation, may amount to about 6,750,000 yards, value above £300,000 Sterling.

Tape.

Tape.—The incle, or tape manufacture, was introduced into Scotland in the year 1732, but it has since greatly declined; and there are now only a few hundred incle weavers at work, on either linen, cotton, or woollen.

Floor-Cloth.—The manufacture of floor-cloth is very inconsiderable. There are only two looms in Scotland, one of which is at Edinburgh.

In regard to the value of the linen cloth manufacture of Scotland, it cannot be estimated at less than £1,400,000 Sterling; and consequently it is an object of material national importance. The trade, owing to the war, and the extension of the cotton manufacture, has certainly declined; the quantity stamped in 1810 having exceeded that of 1812 nearly seven and a half millions of yards. The recent introduction, however, of weaving machinery, or what are termed power looms, may perhaps give fresh vigour to the linen trade.

3. *Threads.*—The linen thread manufacture was introduced into Scotland about the year 1720, and has been since carried on to a great extent in the counties of Aberdeen, Angus, Fife, Perth, Renfrew, Lanark, Mearns, Banff, Moray, and Inverness. This manufacture is divided into two distinct branches, 1st, Coloured or dyed. 2d, White or bleached, which are carried on either separately, or united in one manufactory.

Heddles.—A considerable quantity of linen yarn is still annually made into twine for weavers' heddles; and although these utensils be sometimes made of cotton, woollen, and silk, yet from 35 to 40,000 weavers in Scotland consume flax for that purpose.

The hemp manufacture consists of three branches: 1st, Spinning; 2d, Weaving, or the manufacture of canvass and bagging; 3d, Ropemaking, which includes twine for cording, nets, ropes, cables, &c.

1. *Yarn.*—It is spun into yarn, either by the common wheel, by machinery, or by the shed wheel; and the last is deemed the best mode, when applied to make ropes, and the woof of canvass.

2. *Cloth.*—Hempen yarn generally forms the woof of sailcloth, and many kinds of bagging are entirely constituted of it. The manufacture of hemp bagging is carried on to a great extent at Inverness, Cromarty, and Invergordon in Ross-shire, and also at Aberdeen, Montrose, Arbroath, Dundee, and in many other places in Scotland.

3. *Ropes, Cordage, &c.*—Manufactories of ropes and cordage are established at every sea-port along the eastern and western coasts of Scotland; and employ about a thousand men and boys. In the neighbourhood of the large towns, there are many rope walks for making twine and cording, for mercantile packages, and also ropes for agricultural purposes. The consumption of these articles by merchants, farmers, carriers, &c. is very considerable; but the most extensive application of hemp is in the manufacture of cordage. The total quantity of flax and hemp imported into Scotland for the year 1812, was as follows.

FLAX.

Tons	cwts.	qrs.	lbs.	
6094	4	2	18	at L.100 per ton, is L.609,430 16s. 0½d.

HEMP.

2496 17 1 18 at L.90 per ton, is L.224,718 6s. 0½d.

8591 2 0 8 amounting to L.834,149 2s. 1½d.

These prices have fallen very much since the peace, and the quantity of flax and hemp imported has been nearly doubled.

Such a sum, however, paid for the importation of the raw material to foreign nations, greatly diminishes the value of the flax and hemp manufactures in a national point of view.

The following TABLE *shows the number of persons employed in Manufactures in Scotland of various descriptions.*

I. Manufactures from domestic materials chiefly.	*Persons employed for the use of*			Total persons.
	Scotland.	England.	Foreign parts.	
1. Linen and hemp......	19,000	11,600	46,000	76,600
2. Woollen manufacture	15,900	2,300	6,600	24,800
3. Iron..................	12,400	320	460	13,180
4. Liquors..............	3,695	930	165	4,390
5. Paper................	2,290	350	760	3,400
6. Cooper work..........	1,900	30	680	2,610
7. Leather..............	2,000	100	300	2,400
8. Ship and small crafts	1,150	100	150	1,400
9. Glass................	725	190	325	1,140
10. Soap................	740		70	810
11. Combs and spoons...	580		130	710
12. Pottery, bricks, &c.	500		80	580
13. Salt................	195		10	205
14. Cutlery.............	170		10	180
II. Manufactures from foreign materials.				
1. Cotton..............	7,220	13,600	133,180	154,000
2. Silk................	760	520	1,220	2,5 0
Total............	69,225	29,690	190,090	288,905

The following TABLE *contains a general view of the Manufactures of Scotland.*

	Value of raw material.	Profit of Labour.	Total value.
1. Cotton goods............	£1,832,225	£5,132,362	£6,964,586
2. Miscellaneous goods...	1,300,000	3,700,000	5,000,000
3. Linen goods...........	834,149	940,851	1,775,000
4. Woollen goods.........	300,000	150,000	450,000
Total.........	£4,266,373	£9,923,213	£14,189,586

Cotton.

About the year 1769, cotton was introduced into Scotland as a material for the fabrication of cloth. It was used at first as woof only, the warp being linen yarn. The fabrics thus produced were stout chequered and striped goods, and also plain cloth, which was either printed or dyed.

The cotton manufacture consists of three branches; 1st, Spinning; 2d, Weaving the yarn into a great variety of fabrics; 3d, Thread-making.

1. *Spinning.*—The operation of spinning was originally performed on jennies, consisting at first of from 24 to 28 spindles each; and the yarn produced was of a soft oozy nature, unfit for warps, but well calculated for calicoes, fustians, corduroys, and other stout fabrics. But by the improvements in machinery, cotton yarn can now be made of so fine a quality, that a pound weight will extend nearly a hundred and fifty miles in length, and consequently goods of every texture, from the coarsest corduroys to the finest lace, can be made of cotton.

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Cloth.

2. *Cloth.*—While the English manufacturer made for the market the coarser kinds of cloth, such as calicoes, jeans, fustians, thicksets, corduroys, shirtings, &c. the Scotch directed their attention to the finer qualities. Mull-mulls, and buke or book muslins, were soon very perfectly executed. To these have been added brocades, lappets of all sorts, imitation shawls, plain and Linoe gauzes, spidered, seeded, and numerous species of draw loom, and other work of the most fanciful, delicate, and ornamental kind. Many of these fabrics, with the curious mechanism by which they are executed, are exclusively of Scottish invention. Immense quantities of cambrics, shirtings, sheetings, tweels, stripes, checks, pullicates, ginghams, shawls, &c. are manufactured in Scotland in a superior manner.

Threads.

3. *Threads.*—Within these few years a new species of this article has been introduced, which, succeeding beyond expectation, has almost entirely supplanted linen sewing threads. The method of making them is similar to that employed for manufacturing threads of flax. The yarn is laid two or three ply, and twisted. The twisting process is performed either on a jenny fitted up for the purpose, or on the old Dutch mill. The threads are either bleached or dyed; and sold in hanks, or coiled up in neat balls of different sizes, by an ingenious machine, invented by Mr. Brunel. From the nature of cotton, it is more easily bleached and dyed than flax, and the colours it receives by dying are generally brighter and more beautiful.

Cotton threads are now in general use, and being strong and even, they are fit for every purpose, with few exceptions, to which linen threads could be applied, and they are also cheaper. They have obtained the name of wire threads, and they form an article of profitable exportation to the West Indies and other parts. The total quantity manufactured in Scotland amounts to about 560,000 pounds, of the estimated value of £196,000 Sterling.

Hosiery.

4. *Hosiery.*—The whole number of stocking frames employed in Scotland does not exceed two thousand, and the value of the goods is about £160,000 annually. The weekly wages of a weaver, in this branch, are, on an average, about 18s. 6d. but when the frame is not his own, which is often the case, he has to pay one shilling a week for the use of it.

Machinery.

The machinery for carding, roving, and spinning, was at first extremely imperfect, and was wrought by the hand. Better constructed machines, however, were soon introduced, and the power of a water wheel was applied to the process of carding and roving. The spinning was performed on jennies, consisting at first of from 24 to 28 spindles each, but subsequently increased to 84, 96, 108, and even 120; and the yarn was fit only for the coarsest fabrics.

The next improvement of spinning machinery was Arkwright's water frame, by which that particular kind of yarn termed engine or water twist is produced. This sort of yarn possesses great strength: but when drawn to any considerable degree of fineness, the hardness of the twisting renders it liable to what is technically called snarling, which makes it difficult to manage in the loom. The engine or water twist being found too hard when drawn to great fineness.

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Mr. Crompton invented a machine denominated the mule-jenny in the year 1779. This machine is so perfect, that cotton of a good quality may be drawn to the fineness of 200 hanks in the pound weight. Some of it, indeed, is spun so fine as 312, or nearly 149 miles in length. In Scotland, very little yarn is spun finer than 160 or 170, and the average of the whole by weight is about No. 48.

Arkwright's water-mill, and Crompton's mule-jenny, are the two great inventions in cotton machinery, which have brought this manufacture to so high a state of improvement.

Soon after the invention of Arkwright's machinery, the Scotch entered keenly into the cotton manufacture, and water-mills were erected in many different situations. The first regularly at work was that at Pennycuick near Edinburgh, and those at Barrhead and Johnstone in Renfrewshire; Woodside in Lanarkshire, Paisley in Aberdeenshire, and the very extensive works of the late Mr. Dale of Glasgow soon followed. Owing to the difficulty of obtaining water-falls of sufficient power, mills were erected in situations not well adapted for conducting the business; and the proprietors were often subjected to much inconvenience, as well as great expence, in regard to carriages, &c. and in building houses for the accommodation of their workmen. These inconveniences, however, were in a great measure obviated by the introduction of steam-engines, and the number of cotton-mills was greatly increased; altogether 120 have been erected in Scotland, of which 112 are at present employed, besides several small works in different parts of the country, comparatively speaking of little importance.

The introduction and general use of the fly-shuttle, have greatly tended to promote the cotton manufacture, by facilitating the operation of weaving; and power looms are now used, having been introduced at Stockport in England at nearly the same time. These machines were at first very imperfect; and although only coarse goods can as yet be woven on them, there is still every reason to expect, that in time, they may be made to answer for weaving fine fabrics.

There are 234 power looms at Catrine in Ayrshire, on many of which excellent tweeled cottons for shirtings, &c. are woven; but power looms in general are employed to weave plain cloths for printing. Several large manufactories are fitting up at present for the reception of about 500 of these machines in Lanarkshire, &c. and 1500 are working in Scotland, chiefly in Dumbartonshire, Stirlingshire, Ayrshire, Renfrewshire, and Lanarkshire. There are also sixteen of these looms of the most elegant mechanism working at Grandholme mill, near Aberdeen. These looms have been successfully employed in weaving both woollen and linen cloth as well as cotton; but the last material affords facilities for working superior to the others. These machines are driven by a water-wheel or a steam-engine, and from 10 to 20, according to circumstances, may be wrought by one horse power. The frame and other parts are constructed of cast iron, which is better, and ultimately cheaper than wood. The advantage they possess over the common loom, may be estimated at about 20 per cent. on the amount of weaving, and from 6 to 10 per cent. on the value of the goods; but they are as yet only adapted to the weaving of coarse fabrics.

Preparatory to weaving cotton or linen yarn, it is requisite to dress the warp of the web with starch or some other glutinous substances to smooth its surface, that it may pass easily through the needles and reed. Hence dressing machines were constructed, consisting of two cylinders, in length equal to the breadth of the web; the surface of each being set with bristles forming a brush. These cylindrical brushes dress the warp in revolving as it passes slowly along their surface. The warp is afterwards dried by one or more revolving fanners, driven by the same power that moves the cylinders and the other parts of the apparatus. Dressing machines, however, have made but little progress, there being not more than 60 or 70 employed in Scotland.

Winding machines were recently introduced. Each contains from 20 to 144 spindles, on every one of which there is a bobbin that winds the yarn from the cope.

The flower and tambour work of Flanders was successfully imitated in Scotland; and a great manufacture was quickly established, which flourished beyond expectation. Although still carried on to considerable extent, it has in a great measure given place to hand-sewing, which is applied in every way that fanciful ingenuity can devise. Satin, chain, seed, bead, open, and a variety of other stitches are performed with coloured and white cotton, linen, and silk; and also with coloured worsted, gold and silver thread, spangles, &c. &c. About twelve years ago, a successful attempt was made at Glasgow to tambour muslin by machinery, for which the inventor obtained a patent. A manufactory was then established, and at present there are 16 frames in full employment. Twelve of them having each 54 needles, one inch asunder, tambour 6-4ths muslins, the other four, with 100 needles each, 3-4ths of an inch asunder, are intended for either 8-4ths muslins, or two webs of 4-4ths each. The whole are wrought by power from a steam-engine; and a female attends each, who performs as much work as eighteen girls could accomplish by hand-sewing.*

Some kinds of cotton cloth, before bleaching, are subjected to the process of singeing. The machine employed for this purpose consists of two cylinders, with a handle on the end of each, and they are placed eight or ten feet asunder; the one receives the cloth, while the other delivers it, and *vice versa*. A furnace, surmounted by a cast-iron plate, about eight or ten inches broad, and six or eight feet long, is placed between the cylinders. When the fire in the furnace brings the metal to a red heat, the cloth is wound from one cylinder to another, and both sides of it are alternately passed on the surface of the heated plate. The art of muslin singeing is carried on as a separate business, and the usual price is about a penny for each piece.

The glazing machine was introduced at Glasgow some years ago under a patent. It consists of two rollers, between which the cloth is passed; and as the one revolves quicker than the other, a fine polish is produced on the surface of the web. This machine is capable of glazing about 100 pieces of 28 yards each per day: and the work gives satisfaction to the exporting merchant, both from its quality and the ease with which, in cases of emergency, he can complete his shipments.

The most approved gloss for cambrics and sheetings

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* A full account of the tambouring machinery will be found under our article CHAINWORK.

Commerce and manufactures.

is given by beetling, which was formerly performed by muscular power. The process, however, is now much better accomplished by a machine, which consists of a horizontal cylinder, and twelve or more beetles.

Presses with an iron screw wrought by levers are generally used. Several of Braham's hydraulic presses were lately introduced for this purpose, and have given much satisfaction; but the number in Scotland does not exceed twenty.

With machinery so highly improved, the cotton manufacture has been carried to the highest pitch of improvement, and every variety of goods is made in Scotland, from the coarsest to the finest fabrics; and while the annual value of the cotton manufacture exceeds six millions sterling, it gives employment to 150,000 men, women, and children.

The value of the woollen, linen, (hemp included,) and cotton trades above explained, may be estimated at upwards of eight millions sterling per annum. The hat and paper manufactures, together with that of iron and the other metals, may amount to two millions. Ship-building, and those branches in which timber is chiefly employed, exclusive of the fitting up of houses, is not less than one million. The leather, brewery, distillery, glass, pottery, soap, salt, and tobacco trade, may amount to two millions and a half; and, including the minor branches, it is highly probable that the whole manufactures in Scotland will annually exceed in value fourteen millions sterling, including the price of the raw materials. See our articles COTTON, COTTON SPINNING, GLASGOW, and LANARKSHIRE.

Commerce.

Commercial industry is divided into three branches: 1. The internal or home trade; 2. The foreign trade; and, 3. The carrying trade.

1. *The Home Trade.*—Besides an extensive inland trade, the coasting trade of Scotland is also an important branch of industry, facilitating the conveyance of commodities, and employing a number of ships and mariners. The average number of vessels entered inwards during ten years is about 13,000 annually; and supposing one entry to have taken place every six weeks, or eight entries in the year, the number of vessels employed in the coasting trade of Scotland will be about 1635, carrying upwards of 81,000 tons, and navigated by nearly 6000 men. In the year ending 5th Jan. 1823, the number of vessels was 1823, carrying 92,156 tons, and navigated by 6403 seamen. If 2000 men be engaged in the different canals, ferries, and rivers, the whole number of men employed in this particular branch of maritime occupation will be about 8500.

The account of the trade of Scotland is now given in the following form.

Year ending 5th Jan.	Inwards.			Outwards.		
	Men.	Tons.	Ships.	Ships.	Tons.	Men.
1824	22,650	1,225,685	88,227	21,841	1,117,757	81,291
1825	26,595	1,436,066	100,861	25,153	1,376,221	100,097

2. *Foreign trade.*—Scotland formerly enjoyed but a small share of foreign trade. The exports were chiefly wool, skins, hides, and other raw materials, which were exchanged for corn, wine, and spiceries. Both the extent of exports and imports must have been very limited in those times, at least in Scotch vessels; for the whole shipping, in the thirteenth century, did not exceed twenty sloops, exclusive of the galleys and barks belonging to the Hebrides. In the time of Cromwell, the shipping of Scotland consisted of only 93 vessels, carrying 2724 tons, and 18 barks. Soon after, however, her foreign trade with the northern and eastern states of Europe began to increase, and the Dutch cultivated a friendly connexion with the Scotch, chiefly for the conveniency of prosecuting the herring fishery on the coast of Scotland, in which they were deeply and profitably engaged.

About the middle of the last century, an extensive commercial intercourse was carried on from the ports on the eastern coast of Scotland to Holland, Norway, Sweden, and the different states on the shores of the Baltic. This trade has greatly increased of late years. The imports consist of flax, hemp, yarn, linen, iron, corn, wood, tallow, and other commodities produced in these countries; and in return, colonial produce, cotton goods, and other manufactured articles are exported. The trade between Scotland and Russia, including that of Archangel, forms the most considerable branch of the commerce of the eastern coast; and the chief shipping ports are Leith, Dundee, Arbroath, Montrose, Aberdeen, Peterhead, Bauff, and Inverness. The trade with Spain, Portugal, and the Mediterranean, as well as that of the West Indies, is confined principally to Leith; and the connexion with Canada extends to all the most considerable towns on the east coast of Scotland.

The commerce of the west coast centres almost entirely in the Clyde, which is the grand emporium of the American and West Indian trade. From the middle of the last century, to the year 1772, the merchants of Glasgow imported immense quantities of tobacco from Virginia and the contiguous provinces, which was afterwards exported, both in its natural and in its manufactured state, to every part of Europe, particularly to Holland, where it was carried to the inland markets of the continent. The Americans, in return, were furnished with all those useful and substantial articles which suit an infant state. Since the commencement of the cotton manufacture, the commerce of the Clyde has rapidly increased; and a correct idea of its extent may be formed, when it is stated, that in the year 1810, there arrived at Greenock, Port-Glasgow, and the city of Glasgow, 3308 vessels, carrying 226,837 tons, of which 671 vessels, 107,845 tons were from Ireland and foreign ports.

The following Table shows the state of the foreign trade of Scotland.

Year ending 5th Jan.	Ships.	Tons.	Men.
1816	2775	245,286	17,554
1821	2940	258,748	18,885
1823	2789	228,098	16,926

Carrying trade.

3. *Carrying Trade.*—The Scotch ship-owners enjoy a share of the carrying trade, but it is inconsiderable, and their ships are more frequently employed by English merchants in carrying cargoes to and from America, the West Indies, the Mediterranean, and other parts. Many vessels are also hired by Government as transports; and in both cases make repeated voyages without returning to Scotland. This business is conducted on the capital of the ship-owners, who in general receive ample returns; but it would be difficult to ascertain either the amount of the capital invested, or the extent of shipping employed in this lucrative trade.

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Commerce and manufactures.

The following Table shows the number of vessels built and registered in Scotland during the *eleven* last years, each year ending on the 5th January.

	Vessels.	Tonnage.
1815	136	14,563
1816	165	16,227
1817	172	15,608
1818	156	14,824
1819	131	13,923
1820	154	16,228
1821	121	14,004
1822	122	9,457
1823	87	6,162
1824	117	12,967
1825	189	12,840

In the following Table will be seen the number of registered vessels belonging to Scotland.

	Vessels.	Tons.	Men.
1820	3133	288,770	20,470
1821	3160	289,535	20,855
1822	3071	276,931	29,830
1823	2863	259,444	19,111

Banks.

As connected with commerce, the banking business is a subject naturally entitled to consideration. Besides a number of private banks, there are three chartered ones, 1. The Bank of Scotland, which was established by charter from William and Mary in 1695. Its original capital was L.1,200,000 Scotch money, or L.100,000 sterling; but it has been since augmented to L.1,500,000 sterling. There are sixteen branches belonging to this bank, in the different towns in Scotland, under the management of agents. 2. In the year 1727, the Royal Bank of Scotland was erected by charter. Its affairs are conducted by a governor and deputy, with eighteen ordinary and extraordinary directors, and has one branch at Glasgow. And, 3. The remaining chartered bank, known under the name of the British Linen Company, was established in 1746; but it has diverted its capital from its original destination, (the linen trade) to the purposes of banking. It has at present twenty-seven branches in different towns of Scotland. These three chartered banks conduct business on similar principles. In almost every town in Scotland a bank has been established, and in some two or three; but these banks are private copartnerships, for the purpose of discounting bills of exchange, and selling drafts on London, Edinburgh, &c. They also, like the chartered banks, give cash-accounts, or loans to individuals on bonds of security; and traffic in money matters to a very great extent.

General view of the commercial state of Scotland.

There are thirty banks in Scotland, which issue notes of various amount, payable to the bearer on demand. Several of these banks have branches and agents in many of the principal towns in Scotland; and the total number of places where notes are issued, amounts to nearly three hundred.

General View of the Commercial State of Scotland.

Some idea may be formed of the value and extent of the commerce of Scotland by the following statement.

In the year 1812, there belonged to Scotland 2708 ships, carrying 231,273 tons, navigated by 16,300 seamen. In the same year, the number of vessels that cleared outwards, and entered inwards, including their repeated voyages, was 3151, carrying 278,968 tons outwards, and 3113, carrying 269,559 tons inwards.

The total value of imports to, and exports from, Scotland, for the year 1810, amounted for the former to L.3,671,158 sterling, and for the latter to L.4,740,299 sterling; of which L.4,126,682 sterling was British produce and manufactures. The gross revenue of Scotland for the year 1813, amounted to L.4,843,299, 12s. 11d. of which L 639,132, 5s. 2d. was charged for management, drawbacks, allowances, &c. so that the net revenue was L.4,204,167, 7s. 9d. sterling.

For the year ending 5th Jan. 1825, the official value of the exports from Scotland was £5,899,431, and that of the imports £4,349 990, the excess of exports being £1,549,441. The gross receipt of customs for the same year was £953,969, the drawbacks, &c. 328,063, and the real receipt £625,896.

Fisheries.

Different Fisheries.—The fisheries of Scotland may be classed under the following heads, viz.

1. Salmon fishery.
2. White fishery.
3. Herring fishery.
4. Whale fishery, and
5. The catching of shell-fish,

1. *Salmon Fishery.*—The rivers of Scotland are frequented by immense numbers of salmon, which are caught by nets, yairs, cruives, and other contrivances. The largest rivers are the most productive; and at their efflux, and on their banks, the fishings are the source of great revenue to the proprietors, especially since the method of preserving salmon by means of ice has been adopted.

In consequence of this discovery, the price of salmon in Scotland has been raised at the places where they are caught at least ten fold; and of course the rent of the fisheries has advanced in the same proportion.

Salmon are royal fish, and the right to catch them is conveyed by grant from the crown, on which infeftment proceeds in the same manner as required in the investiture of land. Various statutes have been enacted for the protection of salmon in close, or forbidden time, or during their spawning season, and while the fry pass down the rivers to the ocean. The rights of the respective proprietors of fishings are also protected and regulated by statutes, which are frequently explained by decisions of the Supreme Court.

Salmon, from their scarcity, are a delicacy, which is only within the reach of the more opulent part of the community. Compared with white fish, their price in the markets of Scotland may be ten times higher. The value of the whole salmon caught in the rivers of Scotland is estimated at £150,000 per annum.

In all the rivers of Scotland there are considerable quantities of small fish, such as trout, eels, &c. In some rivers, and in many of the lakes, there are pike and perch; and in a few lakes the char is found. But they are seldom caught in such abundance as to form an article of commerce; with the exception of the trout of Lochleven, which are annually let at £100 of rent.

2. *White Fishery.*—This is a most valuable branch of the Scotch fisheries, both from its extent and its variety. It comprehends every species of white fish, with which the coasts of Scotland so plentifully abound, including haddocks, cod, ling, &c. with all kinds of flat fish. Those who pursue this branch are denominated white fishers, and they inhabit the sea-ports, or reside in numerous villages, along the whole coast of the kingdom. Their mode of fishing is by lines and nets, but principally by the former; and they carry on

their business throughout the year. The fish they catch are daily sold to the inhabitants of the towns and of the country, either as caught or cured. There are various methods of curing them, (particularly the haddocks,) peculiar to almost every district; and of late years, great quantities of cod have been salted for the London market.

3. *Herring Fishery.*—The eastern and western coasts of Scotland are frequented periodically by prodigious shoals of herrings, which penetrate into the bays, lochs, and arms of the sea. They are taken by nets, salted, and packed in barrels. When prepared in this manner, they are termed white herrings; but when smoaked and cured by a particular process, they are distinguished by the name of red herrings.

To promote this important branch of industry, especially in the deep sea, a Board of Commissioners was established by act 48 Geo. III. to superintend and encourage the fishery. A tonnage bounty of £3 per ton is allowed to all vessels of sixty tons and upwards, fitted out for the deep-sea fishery, besides 2s. on every barrel of herrings properly cured and repacked; and by the act 52d Geo. III. c. 153, the bounty of £3 per ton is extended to vessels of 45 tons burden.

Notwithstanding the encouragement thus afforded to the deep-sea fishery, it is not likely to succeed on the system adopted. In 1809 only three vessels were fitted out; in 1810 and 1811 seven vessels; and in 1812 ten; which caught in these several years 700½, 979½, 1588, and 2839½ barrels of herrings. The bounties paid amounted to £5866 for tonnage, which is 19s. 4d. per barrel.

Statistics. Commerce and manufactures.

The coast fishery, however, presents different results. In the above four years 565, 532, 594, and 928 vessels were fitted out, which caught and cured 89,476, 90,849, 109,981½, and 150,646½ barrels; of which the bounty of 2s. was paid on 218,821 barrels of herrings. It must be observed, that the returns made to the Board do not include the whole quantity of herrings caught and cured. It comprehends only the proceeds of those fisheries, which have complied with the regulations of the statute, and are under the cognizance of the officers of the Board. The account received from the excise, of the quantity of herrings caught and cured for the year ending in May 1812, amounted to 190,006 barrels, for which salt, duty free, was used. From various local and other circumstances, it often happens that duty-free salt cannot always be obtained; and it is not estimating the quantity too high, to calculate 10,000 barrels annually caught, and not returned to the officers of excise. The total quantity of herrings taken and cured for the year 1812, may be reckoned at not less than 200,000 barrels, besides 50,000 barrels consumed in a fresh state; which being in all 250 000 barrels, presents a flattering view of the value of the herring fishery.

It was formerly imagined, that the only herring fishery on the coast of Scotland worthy of attention was in the western lochs; but on the eastern coast of Caithness the herring fishery has proved highly successful; above 120,000 barrels have been caught in one year, (an. 1818,) and since that time it has undergone a progressive increase, as will appear by the following abstract:

Years ended.	Total quantity of Herrings cured.			Total quantity of Herrings Branded for Bounty.	Total quantity of Herrings exported.		
	Gutted.	Ungutted.	Total.		Gutted.	Ungutted.	Total.
	Barrels.	Barrels.	Barrels.		Barrels.	Barrels.	Barrels.
5th April, 1810	42,548	47,637½	90,185½	34,701	11,063½	24,784½	35,848
5th April, 1811	65,430	26,397½	91,827½	55,662½	18,880	19,253	38,133
5th April, 1812	72,515½	39,004	111,519½	58,480	27,564	35,256	62,820
5th April, 1813	89,900½	63,587½	153,488½	70,027½	40,100½	69,625	109,725½
5th April, 1814	52,931½	57,611	110,542½	38,184½	34,929	83,474½	118,403½
5th April, 1815	105,372½	54,767	160,139½	83,376	68,938	72,367½	141,305½
5th April, 1816	135,981	26,670½	162,651½	116,436	81,544½	26,143½	107,688
5th April, 1817	155,776	36,567½	192,343½	140,018½	115,480½	23,148	138,628½
5th April, 1818	204,270½	23,420½	227,991	183,089½	148,147½	14,192	162,339½
5th April, 1819	303,777½	37,116½	340,894	270,022	212,301½	14,860½	227,162
5th April, 1820	347,190	35,301	382,491½	309,700½	244,096	9,420	253,516
5th April, 1821	413,308	28,887½	442,195½	363,872	289,445½	5,360	294,805½
5th April, 1822	291,626½	24,897½	316,524½	263,205½	212,890½	2,065½	214,956
5th April, 1823	225,037	23,832	248,869	203,110	169,459½	785½	170,445
5th April, 1824	335,450	56,740¾	392,190¾	299,631	238,505½	1,125	239,630½
5th April, 1825	303,397	44,268¼	347,665¼	270,844½	201,882½	134	202,016½

Along the eastern coast alone the shore herring fishery produces about 300,000 barrels of salted herring annually, besides those used when fresh. The following was the state of it in 1823.

No. of boats employed	2,272
Fishermen	10,435
Coopers	1,585
Packers and labourers . . .	10,041
Seamen in coasting and export ships estimated at	13,500
Total persons employed in 1823	35,561

The value of the herring fishery of Scotland may amount to half a million annually; but when we consider that it may be carried to an extent almost unbounded, and that it is the best nursery for hardy seamen, the fishery may be deemed a source of national wealth, of the highest importance to this maritime and commercial country.

A full account of the history of the herring fishery will be found under our article FISHERIES, Vol. IX. p. 358—362.

Whale fishery.

4. *Whale Fishery.*—This branch of industry is carried on in the seas of Greenland and Davis' Straits. From the state of Europe, it has lately been confined almost exclusively to the British islands; and Scotland enjoys a considerable share. The produce of this fishery is, 1st, Oil, which is of infinite importance, whether for the purpose of affording light, or being used as an ingredient in the manufacture of soap; and 2d, Whalebone, which is manufactured into various useful articles. As the ships employed in this fishery are large, and their equipment expensive, it can only be

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carried on by those who have a great command of capital. Government, however, has afforded considerable encouragement to the adventurers, by allowing large bounties; but the national advantages derived from it, as a nursery for seamen, and as a substantial source of wealth to the country, greatly overbalance any public sacrifice that has been hitherto made for its protection and encouragement.

The profitable nature of this fishery may be illustrated by a single instance. During the last seven years, the four whale ships belonging to Aberdeen have caught 248 whales, which produced 3396 tuns of oil, and 150 tons of whalebone. These may be estimated at £140,000 Sterling in value, or £20,000 a-year. The whale fishery of Peterhead, in 1813, produced £40,000.

Shell-fish.

5. *Shell-fish.*—The lobster fishery is carried on to some extent, principally during the spring months. Immense numbers of this species of fish are to be found along the rocky coasts of Scotland, the Hebrides, Orkney, and Shetland. One fishing in Shetland, it is said, produces about £15,000 worth of this fish annually, which are sent to the London market, where they fetch a high price.

Under the same head may be included crabs, oysters, cockles, and other kinds of shell-fish. They form an object of some importance to the inhabitants of Scotland; and are not only accounted delicacies by the rich, but in particular situations they are found in such abundance, as to constitute a part of the subsistence of the inhabitants. See our article FISHERIES, Vol. IX. p. 362, 363.

In their present state, the fisheries of Scotland, taken in aggregate, are of considerable moment. The following Table will furnish some idea of their amount:

1. The salmon fishery, and other fish in lakes and rivers	£150,000
2. The white fishery, including cod, ling, haddock, &c. and various kinds of flat fish, ...	400,000
3. The herring fishery	500,000
4. The whale and seal fishery . .	200,000
5. Shell-fish	50,000
	£1,300,000
Deduct from this the value of the whale and seal fishery . . .	200,000
And there remains the value of fish for food	£1,100,000

The Scottish fisheries, including the whale fishery, are calculated to furnish the means of subsistence to 128,561 souls, including ship and boat carpenters, &c.

CHAP. V.

ON THE JUDICIAL ESTABLISHMENTS OF SCOTLAND.

Judicial Establishments.

IN the article LAW we gave a very brief account of some of the courts of law in Scotland. Since that article was written, the course of experimental reformation, which commenced about twenty years ago, has proceeded, and a statute of last session of parliament,* has introduced changes of so essential a character, that we find it necessary to resume the subject, and record a fuller and more systematical description of our judicial institutions, down to the latest improvements.

The judicial establishments or jurisdictions of Scotland, are CIVIL, CRIMINAL, and ECCLESIASTICAL, the last of which will form the subject of a separate chapter.

SECT. I. *Civil Jurisdictions.*

The civil jurisdictions are *Supreme* and *Inferior.* The Supreme Courts are, the *Court of Session,* the *Jury Court,* and the *Court of Exchequer.* The Inferior Courts now existing are, the *Admiralty, Commissary, Sheriff, Burgh Royal, Burgh of Regality and Barony,* *Baron, Lyon, Justice of Peace,* and *Commissioners of Supply Courts.* The Admiralty and Commissary Courts are also *supreme* in a certain sense, but are generally classed with the inferior courts, because their sentences are subject to the review of the Court of Session. The *presbyteries* have also civil jurisdiction in regard to schoolmasters, and as to manses and glebes.

The Court of Session is the highest civil judicatory. It was established in the place of two other courts, the *Daily Council* and the *Session,* by the statute 1537, c. 36.† under the name of the *Council* and *Session.* James V. dignified it with the name of the *College of Justice,* and the Judges with that of *Senators of the College of Justice.* The Judges are now, as they were at first, *fifteen* in number, including their president; and are all named by the king. Seven were churchmen till 1640, c. 26; and although that act, as a usurpation act, fell under the general repeal at the Restoration, its spirit has been followed, and no churchman has since sat upon the bench. The court continued to sit in one chamber till 1808, when it was divided into two, called the *First* and *Second Divisions,* the Lord President and seven Judges constituting the first, and the Lord Justice Clerk, (the head of the Court of Justiciary) with six Judges, constituting the second. These divisions have independent, but co-ordinate jurisdiction, and are often called to consult together as the entire Court of Session.

The powers of the Court of Session are very extensive. Its *original* jurisdiction extends to all matters of civil right not under the value of £25, with the exception of *maritime* and *consistorial* cases, *brieves,* and some others, to be noticed in the sequel; and its *powers of review,* by advocation, suspension, or reduction, have no limits, but embrace the decreets of all inferior judges whatsoever, including the Judge Admiral and Commissaries. While its jurisdiction is *cumulative* generally with that of all other civil courts, it is *privative* or exclusive in all competitions of heritable rights, reductions and proving the tenor of deeds, mercantile bankruptcy, *cessio bonorum,* judicial sale, restitution of minors, complaints of irregularities in the election of burgh magistrates and members of parliament, &c. The Court of Session is likewise a court of equity, proceeding not on fixed equity law as in England, but on the rules of conscience, giving aid in the actions brought before them, when there is no remedy in law. It has a yet greater arbitrary power, though now much more sparingly used than anciently, when precedent was less extended and legal principle less settled; this is termed its *nobile officium,* and was used to remedy all contingent public wrongs, so far as even to interfere in market prices. The power to pass *Acts of Sederunt*, as they are called, was likewise in use to trench materially on the law of the land; but has long been limited in practice to regulations or rules for judicial forms. This is recognised by the very latest statutes; for by the stat. 6. Geo. IV. c. 120. the Chief Commissioner of the Jury Court is joined to the Lords of Session, and power given to them jointly to make orders and regulations for the Court of Session, Court of Teinds, Jury Court, and all the inferior courts. Such by-laws, being sanctioned by statute, have the force of statute so far as they go.

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* 6 Geo. IV. c. 120.

† Some lawyers say 1532 is the proper date, but it is 1537 in the printed acts.

There are three stages of judicial business in the Court of Session, viz. the *Bill Chamber, Outer-House,* and *Inner-House,* which last, both divisions are alike denominated. Causes originating in the Court of Session as ordinary actions, do not pass through the Bill-Chamber. This last is the first stage of the process of review of the judgments of inferior courts; and in this stage it is determined whether these should be admitted into the supreme court, or remitted, as properly decided, to the inferior judicatory. The Bill-Chamber, besides, is the jurisdiction for all summary and urgent process, as interdicts against illegal proceedings, relief from illegal execution, imprisonment, &c. and, having no vacation, is always accessible. The judges, with the exception of the Lord President and Lord Justice Clerk, officiate in rotation during vacation; and one judge, the junior of all, does the duty in time of session. Nearly all decisions in the Bill-Chamber are subject to the review of the Inner-House.

Formerly the Inner-House judges sat by rotation in the Outer-House as Lords Ordinary. After several experiments, permanent Lords Ordinary were established; and by the stat. of last session, 6. Geo. IV. chap. 120. these are put upon their present footing, viz. the *seven* junior Lords of Session sit in the Outer-House as permanent Lords Ordinary; subject to be occasionally called into the Inner-House whenever the whole fifteen judges consult on any cases in which one division requires the opinion of the other. The seven permanent Lords Ordinary prepare and judge in causes in the Outer-House, both such as originate in the Court of Session, and such as have *passed* the Bill-Chamber; and the Lord Ordinary on the bills has the special duty of judging in rescissory actions or reductions, and some other cases which are remitted from the Inner-House for discussion in the Outer.

The Inner-House of each division (by the same act) consists of a president and three ordinary judges. The Lord President presides in the first division and the Lord Justice Clerk in the second. The judgments pronounced in the Outer-House are subject to the review of the Inner. In consequence of a more mature and perfect preparation of the cause under the prescriptions of the new act, there is no longer any form for submitting his own judgment to the review of the Lord Ordinary; but the losing party presents a note to the Inner-House (instead of the old form of reclaiming petition,) reciting the judgment of which alteration is craved, and prints along with it, the proceedings held before the Lord Ordinary, called the *record,* including *cases* if they have been ordered, so that nothing in fact or law is laid before the court of review that was not in the view of the Lord Ordinary. The Inner-House, in both its divisions, is entirely occupied with this its province of review, with the exception of cases of a certain kind which are not competent in the Outer-House, and come at once into the Inner, such as petitions and summary complaints in bankruptcies, complaints in elections, appointment of judicial factors, *curatores bonis,* &c.

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Appeal to House of Lords.

The judgments of the Inner-House are subject to the review of the House of Lords, as coming by the Union in the place of the Scottish parliament. In this final review the same salutary principle is rigidly observed, namely, that the court of the last resort shall judge on the same pleadings in law as were before the court below.

Advantages of the new regulations.

The principal advantages intended by the new regulations, not only in the Court of Session but in the inferior judicatories, to all of which they apply, are complete production in the outset of documents founded on; greater accuracy, precision and brevity of pleading; and a complete separation of the facts of the case from the law; and, as the latter only is to be made the subject of discussion in the House of Lords, much diminution of that excess and complication of appeals, which had become so great a grievance to the judges in that high tribunal. The parties are forced to bring out their whole cause, in fact and law, in their original pleadings, *when the record is closed*, and no farther facts or pleas allowed, except of matters newly come to knowledge, when the payment of a suitable part of the previous expences must be made before these are admitted. This will render legal proceedings not only more precise and brief, but more respectable than when parties in a law-suit watched each other, and let their strength out by degrees; when cunning was mistaken for legal skill, and slovenliness and inaccuracy rendered disputes inextricable, and delay intolerable.

In all causes not expressly allotted to the Jury Court, of which in the sequel, where the facts are either not admitted or not ordered to be ascertained by evidence taken on a commission, and chiefly in distant places, the Lord Ordinary may, if he sees proper, send the whole facts, or such part of them as he may think necessary in the form of particular issues to be tried by a jury in the Jury Court. The verdict of the jury finally settles the facts, so that no question of *fact* tried by jury can now be the subject of discussion by way of review either in the Inner-House or House of Lords. No facts can in any case be now discussed in the court of the last resort, inasmuch as the judgment on the facts by the Court of Session, when the matter has not been tried by jury, has the force of a verdict. When the verdict of the jury is returned, or the facts otherwise disposed of, the Lord Ordinary decides the cause, or takes it to report, as it is called, that is, to be decided at once by the Inner-House. If he decides it himself, the party dissatisfied carries it to the Inner-House by a *reclaiming note,* and prints the pleadings, called the *record,* which has been made up before the Lord Ordinary. On this record the court decide, *after hearing counsel,* either without or with farther written pleadings, in the form of concise *cases,* as they think fit. By these forms it is expected that written pleadings, which rendered the course of law cumbrous and tardy, will be very essentially abridged, and the Scottish bar be called to a greatly increased exercise of the more strictly forensic talent of *viva voce* statement.

Court of Teinds.

The Court of Session has another function or character. It is the *Commission,* as it is called, *for the plantation of kirks and valuation of teinds.* This commission was, after several temporary commissions, rendered perpetual by statute 1709, c. 9. The whole fifteen judges sit in this court, and the old quorum of

Judicial Establishments.

nine is requisite. Its meeting takes place every alternate Wednesday in Session time; and, as a distinct court, it has its own clerks, but is attended by the same practitioners. The act 1707 details its powers and duties. It regulates valuations and sales of teinds, augments the stipends of the clergy, disjoins or annexes parishes according to exigency, erects new churches, &c. The cases in this court go through their stages in the Outer-House before the Lord Ordinary on the bills.

Jury Court.

There is a class of actions in which no discretion is left to the Lords Ordinary of the Court of Session, to send or not to send, wholly or partially, the facts to be tried by jury. Cases of this class, although they must all originate in the Court of Session, (for the Jury Court has not been raised higher than a sort of accessory although supreme court,) must be sent at once for entire trial and determination to the Jury Court, without remaining longer in the Court of Session than passing through the form of being remitted, without any previous discussion of law or relevancy. This class of cases embraces actions of damages for injury to the person, both real and verbal, as assault and defamation, for injury to patrimonial rights, for breach of contract, for injury by delinquency and *quasi* delinquency; all actions on the responsibility of carriers, ship-owners, inn-keepers, actions to abate nuisances; all actions of reduction on furiosity, idiocy, facility, lesion, force, or fear; all actions on insurance of all kinds, on charter parties, &c. Such of this class of cases as must originate in the Court of Admiralty, must likewise be sent at once to the Jury Court, provided the amount shall be £40 and upwards. The Judge Admiral, like the Lord Ordinary, has an option to remit or not cases not of this class. The Jury Court have the power to remit back points of law in the class of cases allotted to it, to the Lord Ordinary or Judge Admiral. When points of law are sent back to the court, the facts come again to be tried in the Jury Court. If in the Jury Court the facts are admitted on both sides and trial of them unnecessary, the case is sent back for decision by the courts from which it came.

From the year 1815, when the trial by jury in civil cases commenced till the passing of the late act, (July 1825,) the judges of the Jury Court were only *three* in number; a chief commissioner and two ordinary commissioners, called Lord Commissioners of the Jury Court in civil causes, and eligible from the Lords of Session or Barons of Exchequer, with the exception of the Chief, who must be qualified to be appointed a Lord of Session. By the late act *two* additional ordinary commissioners have been added to the number. The Jury Court has its *terms* and *sittings*, after the manner of the courts in England; and the judges travel circuits twice a-year, nearly at the same time with the Lords of Justiciary. The trial itself is conducted pretty nearly upon the English model. The jurymen are twelve in number, chosen by ballot from a list returned by the Sheriff, and they are required to agree in their verdict.

The Jury.

Civil jurisdiction of the circuit Court of Justiciary.

It is necessary to mention here the Court of Justiciary or supreme criminal court, as exercising by statute a certain *civil* jurisdiction. This is only on the circuits, and arose from the convenience of the presence in the circuit towns of judges who were Lords of Session. By 20. Geo. II. c. 43; and 54. Geo. III. c. 67. this jurisdiction is bestowed by way of appeal from the sentences of inferior courts, in all cases not exceeding £25 in value exclusive of the costs. This decision is final, unless the circuit judges certify the case, as they may do, to the Court of Session.

The Court of Exchequer is the court of the revenue. It was remodelled at the union on the English form, and consists of the Lord High Treasurer of Great Britain, a chief baron, and three ordinary or puisne barons,* who must be either serjeants at law or English barristers, or Scots advocates of *four* years standing. This court "has a peculiar jurisdiction as to all duties of custom or excise, and other revenues pertaining either to the king or prince of Scotland, and as to all honours and estates real and personal, forfeitures or penalties of what nature soever arising to the Crown within Scotland; and as to all questions relating to the said matters which they are authorised to determine either in law or equity by the same forms that have been used in the English Exchequer." (Ersk. 1—3. 31.) By the 3d Geo. IV. c. 91. the jurisdiction of this court has been increased by the power to judge in all complaints by burgesses against borough magistrates in relation to their administration of the revenue or *common good* of the borough. Although this court judges by the forms of the English Court of Exchequer, the real estate of the debtor must be attached, and all questions regarding it determined by the rules of the law of Scotland; and when the Crown's title to honours or lands is disputed, the Court of Session is the proper jurisdiction.

In our articles Admiral and Admiralty, we gave some account of the former Lord High Admiral of Scotland, and of the Vice-Admiral, who is still appointed, although his duty is done by the Judge-Admiral, whose office is now entirely judicial, and both civil and criminal. (See statute, 1681, c. 16) Although styled an inferior court, this is only relatively to the Court of Session, which has the power of reviewing its decrees; but it is a supreme court in respect of its exclusive jurisdiction, in the first instance, in what are strictly *maritime* causes, such as freight, salvage, charter party, damage done at sea, wrecks, &c. It has also, cumulatively with the Court of Session, jurisdiction in *mercantile* cases, such as bills of exchange, contracts, insurance, &c. provided the issue be not of less value than £25, (1. & 2. Geo. IV. c. 39.) As already stated when treating of the Jury Court, the Judge Admiral may remit certain cases, and must remit others to that court for trial (6 Geo. IV. c. 120.) The same act takes expressly from the High Court of Admiralty of Scotland, and vests in that of England, all jurisdiction "in questions and matters relating to prizes and capture in war, and condemnation of vessels as such, any law or practice to the contrary notwithstanding." The Vice-Admiral, or now rather the High Court of Admiralty, has the power of naming inferior deputies, with local jurisdictions, whose sentences are subject to review by the high court. The Magistrates of Edinburgh claim an independent right of admiralty in the port of Leith, emanating from the Crown, and not from the Court of Admiralty or the Vice-Admiral. This matter is disputed by the Judge-Admiral, and is not yet determined. The High Court of Admiralty can review its own judgments, even after extracted decree, and that both by suspension and reduction. This power alone is sufficient to constitute this judicatory supreme, although its decrees are subject to review in the Court of Session.

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* The legal number is *four* ordinary barons, but on a late vacancy the expediency of filling it up was carried in parliament by so small a majority that it was not filled up, and has not since been.

The Commissary Court is entitled to the next place, and is also in one view supreme and in another inferior. This was an ecclesiastical court before the Reformation; but in 1560, a commissary was appointed by Queen Mary to act under the royal authority in every diocese; and soon afterwards a supreme court of four judges (their present number) was instituted at Edinburgh, with power of reviewing the sentences of the diocesan commissaries. The Supreme Court had likewise a diocesan jurisdiction in the county of Edinburgh and several contiguous shires. Since our notice of the Commissary Court in the article LAW, this jurisdiction has been materially changed by the abolition of the inferior or diocesan commissaries, and the transference of their jurisdiction to the sheriffs, subject to the review not of the Supreme Commissary Court, but of the Court of Session, (4 Geo. IV. c. 97.) The jurisdiction of the Commissary Court is privative, in the first instance, in all consistorial causes, as questions of marriage, divorce, separation, legitimacy, confirmation of testaments, and cumulative with that of the sheriffs and other civil courts, in actions of slander, aliment of wives, sealing the repositories of deceased persons, &c. The jurisdiction formerly exercised by the Commissary Court in questions of debt, is taken away by the statute last above quoted.

Anciently the shires or counties, or *comitatus*, were governed by the *comites* or earls, in place of whom Sir Thomas Craig thinks the sheriffs or vice-comites were subsequently appointed by the king. He derives the word sheriff from the Saxon *grave*, a term still subsisting in the Scotch word *greeve* or overseer. Spelman with greater probability compounds the word of *sheer*, to cut or divide, and *reeve*, magistrate,—the *reeve* of a *division* of the kingdom. In England, several places, as Manchester, have their Borough-reeve to this day. Still the Vice-comes or Sheriff retained the title of High Sheriff, and had almost unlimited power within his territory. The jurisdiction act (20 Geo. II. c. 43.) put the office on its present footing. The *High Sheriff* still exists nominally in each county, but without judicial authority, and his executive powers are exercised by him as Lord Lieutenant. The Judge Ordinary of the county is the *Sheriff Depute*; who is appointed by the Crown, and is altogether independent of the High Sheriff.* Some counties had the denomination of *Stewartries*, of which Kirkcudbright is the only existing instance; of this county the Judge Ordinary is called the *Stewart Depute*; but his office differs only in name from that of his brethren the Sheriffs. The Sheriff's power is both judicial and ministerial. His judicial power, as a civil judge, is exercised in "all personal actions upon contract, bond, or obligation, to the greatest extent, whether the suit be brought against the debtor himself or his representatives; in actions of rent and of forthcoming; in poindings of the ground; and even in adjudication of lands when it proceeds upon the renunciation of the apparent heir; in all possessory actions, as removings, ejections, and spulzies, &c.; in all brieves issuing from Chancery, as of inquest, terce, division, tutory, &c.; and in general in all civil matters which are not by special law or custom appropriated to other courts." (Erskine, 1, 4, 3.) The Sheriff judges in questions of straighting boundaries, dividing runrig lands, mutual inclosures, &c. By the statute, 4 Geo. IV. c. 97, the Sheriff is constituted the *Commissary* of the county, upon the abolition of the inferior or diocesan commissariots. Of the Sheriff's criminal jurisdiction, we shall treat in the sequel under its proper head. Ministerially the Sheriff is the police magistrate of his territory; the officer through whom all proclamations and acts of government reach the county; he presides at county courts of freeholders, in the absence of the member for the county; receives and returns the writs for election of the representatives in Parliament, returns juries, strikes fiars or prices of corn, &c.

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Sheriff substitute.

The Sheriff appoints his own *substitute* or under sheriff; of which there are two and even three in some of the larger counties. He reviews their judgments, while his own are subject to the review of the supreme court. He can hold courts any where within his territory, on previous notice at the church doors. The form of procedure in the sheriff courts, by the late statute, or rather by an act of sederunt of the Court of Session under authority of that statute, is, as nearly as possible, assimilated to that of the supreme and all other civil courts in Scotland.

Bailie Court.

The courts of the boroughs-royal are two, *the Bailie court*, and *Dean of Guild court*. Some boroughs have no dean of guild; in which case the duties of that peculiar jurisdiction belong to the bailie court. The bailie court is just a sheriff court within the borough, exercising civil jurisdiction cumulatively with the sheriff in the same classes of questions in so far as applicable to a borough, and having a summary power in alimenting prisoners and liberating them on sick bill, &c. All possessory questions, not involving title in heritable property, are likewise competent before this court.

Dean of Guild Court.

The Dean of Guild, as the name imports, was anciently the judge in mercantile matters within the borough, and likewise of questions between merchant and mariner. The statute 1681, c. 16. took away the maritime part of his jurisdiction, and vested it in the Court of Admiralty. For a long period the dean of guild has abandoned the mercantile department likewise; his chief and now only province being to take care that buildings within burgh are agreeable to law, neither encroaching on private property, nor on the public streets or passages, and that houses in danger of falling be thrown down. (Erskine, 1, 4, 24.) In this department the jurisdiction of the dean of guild is exclusive, but subject, as is that of the bailie court, to review by the Court of Session, and circuit Court of Justiciary.

Assessors.

The magistrates are assisted in their judgments by assessors; in the more important boroughs these are advocates, in others they are the townclerks, who are always professional lawyers. In some boroughs all the magistrates are justices of the peace, *ex officio*, and since the Union the senior magistrate of every royal borough is named, of course, in the commission of the peace.

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* As the sheriff-depute is not the deputy of the high sheriff, as is erroneously believed, but of the king, the title of depute is improper. It is applied to no other officer of the crown, and it is believed to be in agitation to give this officer his proper title of *sheriff*.

Judicial Establishments. Courts of Boroughs of Barony and Regality.

Boroughs of Barony and Regality are towns under the feudal superiority of a baron or overlord, but erected by the king, sometimes, but not always, with power to choose their own magistrates, which power is in others vested in the superior. The superiors, before the jurisdiction act, but not since, exercised a cumulative jurisdiction with the magistrates of these boroughs. This act, however, reserved their jurisdiction to the boroughs of barony and regality. The powers of the courts of these boroughs is nearly the same as that of the courts of boroughs royal. By 35 Geo. III. c. 122, the king is empowered to erect free and independent boroughs of barony on the sea coast, for encouraging the fisheries; to the magistrates of which the powers of justices of the peace only are given.

Baron Courts.

Some proprietors of landed estates erected into what is called *liberam baroniam*, keep up the formality—for it is little more and rarely used—of holding a court, by a deputy called the baron-bailie, for determining disputes among the tenants and neighbours not exceeding forty shillings in value; or in questions as to the rents of the lands or multures to the mills. These *very* inferior courts were put upon their present harmless footing by the jurisdiction act. (20 Geo. II.)

Lyon Court.

The *Lyon king at arms* is an inferior judge. His name is derived from the lion on the armorial bearing of the Scottish kings. His powers are "to visit the arms and ensigns armorial of all persons; to give proper arms to deserving persons, and to fine all who use arms not matriculated, and confiscate to the king the articles on which these are painted or engraved." The Lyon's most important powers consist in the appointment and suspension of heralds, pursuivants, and messengers at arms. The Court of Session also suspend the office of messenger, by act of sederunt 4th November 1738. Anciently the Lyon carried public messages to foreign states; and he still publishes, in state with his attendants, the King's proclamations.

Justices of Peace.

Magistrates to preserve the public peace were appointed by the Romans. *Irenarcha* was the name of these officers. *Justices of peace* were appointed in England in the second year of Edward III. but not in Scotland till 1609, c. 7. Since which their powers and duties have been varied and modified by statutes both Scottish and British. Their original appointment was for the purpose of binding over disorderly persons for appearance before the justiciary or privy council. Subsequently power was given them to judge in riots and breaches of the peace, to oversee the repair of highways, and execute the laws against beggars, vagrants, swearers, drunkards, and other disorderly persons. They are now, besides these powers, competent to questions of servants' wages, aliment of natural children, *meditatio fugæ* warrants, and imprisonment of debtors so apprehended till they find security *de judicio sisti*. All questions of highways, toll-bars, bridges, ferries, are appropriated to them. One large department of their jurisdiction is in executing the excise and customs laws against smugglers, &c. They have no longer the power to fix artificers and labourers wages. (53 Geo. III. c. 40.)

Small Debt Court.

By 35 Geo III. c. 123, the small debt act, the most important jurisdiction of the justices was established, in all questions of debt not exceeding forty pounds Scots. The experiment succeeding, the small debt jurisdiction of the justices was rendered perpetual by 39 and 40 Geo. III. c. 46, and the sum extended to £5, sterling. These courts are held weekly, once a fortnight, or once a month, as required. The statute is precise as to fees, which are very moderate; and all procurators and written pleadings are excluded, so that the parties, or a member of their family, must appear and conduct their own causes. The judgments are final, if not challenged within a year by reduction on the head of iniquity or oppression; the reducer finding surety for such expences as may be awarded against him. In all other branches of their civil jurisdiction, the sentences of the justices are subject to the review of the Court of Session or circuit Court of Justiciary. There is an appeal to the quarter sessions from the judgments of the ordinary justices. The quarter sessions are the meetings of the justices of a whole county, appointed to be held four times a year.

Commissioners of Supply.

The *Commissioners of supply* are appointed by Parliament, in their acts of supply, to levy the land tax in Scotland. They determine differences as to proportions of land tax between the seller and purchaser of lands, and are competent to all disputes about assessment, subject however to the review of the Court of Session.

SECT. II.—*Criminal Jurisdictions.*

Criminal jurisdictions. High Court of Justiciary.

The *High Court of Justiciary* is the supreme jurisdiction in Scotland for the trial of crimes. It consists of six judges, who are also Lords of Session, the Lord Justice Clerk presiding. It has a nominal head, called the Lord Justice General, who however never presides. Of the court sitting in Edinburgh, *three* are a quorum. On the circuits two judges travel together, but one can sit alone. Scotland is divided into three circuits, the north, west, and south; each circuit having three districts of several counties each, the circuit town of the district being the county town of one of the shires of the district. The north circuit towns are Perth, Inverness, and Aberdeen; the west are Glasgow, Stirling, and Inverary; and the south are Jedburgh, Dumfries, and Ayr. This court is competent to the trial of all crimes, including high treason; though this last is generally tried by a *commission of oyer and terminer* appointed by the Crown. As a court of review in criminal matters, the proceedings of all inferior criminal judicatories, including the Court of Admiralty, are subject to it. The circuit courts can review the sentences of all inferior courts, which infer "neither death nor demembration." There is, however, no appeal from the Court of Justiciary to the House of Lords, or to any other tribunal.

The jury.

The trials in this court are and have long been by jury. The jury's number is *fifteen*, and a majority decide the verdict. By 6 Geo. IV. c. 22, power has been given to juries to pronounce *viva voce* verdicts, even when not unanimous, instead of the old method, of written verdicts sealed up; which last, however, the court may still direct. After much discussion in Parliament and in the country on the mode of returning and choosing juries, the same statute has enacted that the sheriffs shall make lists of qualified persons in their counties, and keep a book for general, and another for special juries as qualified by 55 Geo. III. 42. From these books lists are to be made out by regular rotation, one-third being special, from which lists the juries to try the causes are to be chosen by ballot in court. In criminal trials a right is given to each party to challenge five jurors, but only two of them special, without assigning any reason; and any others on cause shown.

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It is not wonderful that a court of such undefined power as was once the Court of Session, should have exercised power to punish crimes; but the cognizance of certain crimes has been bestowed on it by statutes, *viz.* deforcement of its officers and breach of arrestment, contravention of lawburrows, perjury and subornation of perjury arising out of process in its own court, fraudulent bankruptcy, from the long duration of its evidence being unsuitable to the peremptory diets of the Court of Justiciary, improbation and forgery, falsehood committed in the course of their own proceedings, &c. It proceeds without a jury.

By the act 1681, c. 16, the High Admiral is declared "as the King's Lieutenant and Justice General on the seas, and in all harbours and creeks, and upon fresh water within the flood mark," to have the sole jurisdiction in all maritime and seafaring causes within this realm. He is competent exclusively to try piracy, mutiny on ship board, and all crimes strictly maritime; but only cumulatively murder on shipboard and other crimes not connected with navigation. The Court of Justiciary has frequently sustained its own jurisdiction to try such crimes, although committed within sea mark, as in the case of Mungo Campbell, who murdered the Earl of Eglinton within sea-mark. Capital punishment may follow the sentence of the judge admirals, an instance of which occurred in 1822 of two men for a flagrant act of piracy and murder committed on the high seas. The trial in this court is by jury.

The sheriff is competent to the trial of all crimes except treason, and the four pleas of the crown, as robbery, rape, murder, and wilful fire-raising. It was the ancient law that the sheriff could try murder when the offender was immediately taken—*redhand* as it was called, in which case execution within one sun was to be done upon him. This, however, has long been relinquished, as unsuitable to the calmness and dignity of more modern criminal judicature. The sheriff, however, may try house-breaking, theft, and all lesser crimes down to gross immoralities, and breaches of the peace; and although he cannot transport, he can try capitally. This power, however, is never exercised now-a-days. The criminal jurisdiction of the magistrates of boroughs, who exercise the power of sheriffs within borough, are much the same with that of the sheriffs. In important cases the sheriffs try by jury.

The justices of peace have a criminal jurisdiction in riots, breaches of the peace, poaching, &c. Their chief duty is securing offenders, and taking precognitions to be reported to the crown officers.

The lawyers of the Crown are the *Lord Advocate and Solicitor General.* The first, besides most important ministerial powers and functions which constitute him virtually the minister of the Crown for Scotland, is the public prosecutor of all crimes coming before the Court of Justiciary and Admiralty Court, and in all revenue offences tried before the Court of Exchequer. He and the Solicitor General are advocates practising at the Scottish bar. The latter officer is virtually the Lord Advocate's coadjutor and substitute for the whole of Scotland. His lordship has, besides, three deputies, called Advocates Depute, each of whom goes one of the circuits as public prosecutor, with the full powers of his principal.

The Scottish bar is called the *Faculty of Advocates.* They have exclusive right to practise in the supreme courts; and are under no disqualification to plead in any court, down to the most inferior.

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Judicial Establishments.

The Writers to the Signet are the first order of attornies in Scotland. They keep and have the sole right to use the king's signet, as applied to writs in the king's name. They were antiently clerks to the secretaries of state, but are now general conveyancers and practitioners before the courts of law.

Solicitors in the Supreme Courts.

A certain class of agents practise in the supreme courts, who are not writers to the signet, called *Solicitors before the Supreme Courts,* and lately incorporated, by royal charter, as such.

Procurators.

The inferior courts have their own *Procurators,* or *solicitors,* who are admitted by the different inferior courts.

Notaries Public.

Notaries Public are now admitted by the Court of Session. Almost all the writers to the signet and solicitors both of supreme and inferior courts are notaries.

Seals.

All the supreme courts have *Seals* proper to themselves, with which their writs and warrants are sealed. All the Court of Session writs are stamped with the king's signet, and signed by a writer to the signet.

Registration.

There is no part or accessory of the judicial establishments of Scotland more perfect than its system of *Registration.* There is hence much more security and confidence in legal transactions than exists in any other country of Europe. Besides the particular record of each court, there are the records of chancery for patents, services of heirs, &c.; the record for all rights affecting lands for the information of creditors, called the register of sasines; (Stat. 1617, c. 16.) the record for interdictions, inhibition, hornings; the record of bonds, bills, and other obligations to found personal diligence. This last registration has the form of a judicial proceeding, by fiction of law, for no judge is present; and the books of record for that purpose are those of council and session. The stat. 1696, c. 26, established the register for probative writings in which a clause of registration has been omitted. The record of entails is also a very important record. It is the essential character of the Scottish registration, where the safety of creditors is the end, that the writings are null and void if registration is omitted.

An account of our ecclesiastical judicial establishments is given in its place in the following chapter.

CHAP. VI. ECCLESIASTICAL STATE.

Ecclesiastical state.

What was the religious system observed by the ancient Caledonians before the invasion of the Romans, it is now impossible to determine. On the arrival of Cæsar, the south of Britain could boast of the Druids, a class of men comparatively enlightened: but there is no proof that they were ever known in Scotland. From the classic writers, to whom we owe all we know on the subject, we learn that Druidism was established in France, in the south of England, and in Wales; and the opinion sometimes entertained and insisted on, that it was extended to the northern parts of the island, is founded solely on conjecture. It has indeed been argued that Druidism was the religion of the Celtic nations, and that, as Scotland was inhabited by the Celts, that system must have obtained there. Cæsar, however, affirms that it had its origin in the south of Britain, and was thence translated to Gaul; a circumstance which proves it to have been local, and not the religion of the whole Celtic people. "Since," to use the words of a celebrated writer, "it must have begun to exist after the Celts left their original settlements, it must be considered as British not Celtic; and it would be as absurd to extend it to all the Celts, because it originated among them, as it would be to expect to

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Ecclesiastical state.

find the institutions of secret tribunals in the thirteenth century among the Swedes as well as among the Germans, merely because they were both Gothic nations." In addition to this argument, Tacitus, it may be mentioned, is totally silent on this subject. He relates that Suetonius, after having vanquished the Britons in Mona, cut down and destroyed the consecrated groves of the Druids: but, in writing the history of the campaign of Agricola in Scotland, he never once alludes to this order of men; and as the Druidical institution was so singular and so deserving of attention both in a religious and political point of view, it would be impossible to account for the silence of Tacitus respecting it, if it had really been known in the country which he describes. Negative evidence is nearly all we can obtain on the subject, and we hold the preceding as an irrefragable argument in our favour. Nor is the existence of the well-known circle of stones any better proof than the preceding that Druidism existed in Scotland. "For Druidic antiquities," says Dr. Irving, "it would be in vain to search; instead of temples and other edifices they consecrated the misletoe and the oak on which it grew." *Nihil habent Druidæ visco et arbore in qua gignatur, si modo sit robur, sacratius.* (Plinii *Nat. Hist.* xvi. 95.) Besides, the greater number of these stone monuments, if not the whole, were political and not religious structures, being used as courts of election and of police. It is a matter of even recent Highland tradition that the chiefs were elected and invested in these circles, as was formerly the custom of Norway, where their erection for those express purposes is historically recorded.

To Druidism, then, Scotland owes no obligations. Nor have we any intimations relative to the religious belief of our ancestors previously to the introduction of the Christian religion; an event which took place as early at least as the beginning of the fifth century. According to some writers this event should be referred to a much more remote date, nearly 200 years before the period just mentioned. But Bede (*Hist. Eccl.* iii. iv.) the earliest writer on this subject, mentions that Scotland was not freed from idolatry and heathenism till the time of St. Ninian, bishop of Candida Casa. Ninian was born near Leucophibia, the site of Candida Casa, now Whithorn, in 360. He was educated abroad; and after being ordained at Rome bishop of the Britons and instructed in monastic discipline by St. Martin of Tours, he returned to his native land about the end of the fourth or beginning of the fifth century. He erected a church at Leucophibia, which is emphatically mentioned by Bede as the first built of stone, and as obtaining from this circumstance the appropriate name of Candida Casa. But Ninian did not confine his labours to Leucophibia and its neighbourhood, but, travelling north, he preached the gospel, we are told, to the Picts who lived between the Grampians and the Forth. What was the result of this pious expedition we have no minute information, but notwithstanding the characteristic zeal and perseverance of Ninian, (who after a long life spent in teaching the most important truths died in 432) we know that the greater part of that people remained unconverted till the time of St. Columba, when the king and nobility having abjured paganism and received baptism from the saint, the whole population were at once reduced to follow so illustrious an example.

St. Columba, born of royal parentage in 521, was a native of Ireland, where, before this period, Christianity had been established. Having been educated under the most eminent monks, and having visited the continent of Europe, and, according to some, travelled to Jerusalem, he was seized with an ardent desire to propagate the gospel in countries where it was not then known. Accordingly, attended by twelve friends as assistants, he set out for the west of Scotland in the year 563, and having landed on the island of Hi or Iona (called also I-colum-kill, the isle of the cell of Columba) founded a monastery there, which was afterwards so distinguished, and justly denominated "the luminary of the Caledonian regions." St. Columba, in conjunction with his followers, not only preached the gospel in different provinces of the kingdom, but opened in his institution in Iona a seminary of education, particularly for the benefit of persons intended for the sacred profession. "His monastery," says Dr. Smith, "was the chief seminary of learning perhaps in Europe, and the nursery from which not only all the monasteries and churches which he himself had established, but also many of those in neighbouring nations, were supplied with learned divines and able pastors" (*Life of Columba*, p. 18, 19.) The number of monastic establishments founded by Columba is said to have been exceedingly great, no less than a hundred according to some writers; while his churches have been reckoned at three times that number. His jurisdiction extended to the greater part of the mainland of Scotland, to a large proportion of Ireland, and it was acknowledged in different districts of England and Wales.

As St. Columba emigrated from Ireland attended by twelve of his friends as assistants, his monastic and literary institutions consisted of twelve brethren, with an abbot or superior who presided over them, a practice which may have been introduced from the east, as Columba is supposed to have extended his travels to Jerusalem. They were termed *Culdees*, a term supposed to have been derived from two Irish words signifying servants of God. The doctrines and discipline of the Culdees were drawn immediately from the scriptures; they were remarkable for their simplicity and purity, and were quite distinct from those of the Romish church, and often contrary to them. They did not practise auricular confession; they denied the doctrine of the real presence; they paid no idolatrous worship to saints and angels; they did not inculcate celibacy on their clergymen; and in several other points they were opposed to the Romish faith. One great accusation brought against them was that they neglected to observe the statutes of the "Holy Fathers." The Culdees of Iona indeed, obtained the name of the "Apostolic Order," as their piety and purity resembled those of the early Christian times; "they preached," says Bede, "only such works of charity and piety as they could learn from the prophetical, evangelical, and apostolical writings." The Culdees continued to flourish for several centuries; they were considerably reduced both in number and influence in the twelfth century: and in Dunkeld and Monymusk they continued to support a feeble existence for two centuries longer. Their chief seat in Scotland, in addition to the two places just specified, were at Dumblane, Brechin, Montrose, Scone, Kirkcaldy, Culross, Melrose, Inchcolme, and Dunfermline.

"The first check to the celebrity and influence of Iona was the invasion of the Norwegians and Danes in the beginning of the ninth century. By them it was repeatedly pillaged and burnt, and its monks and abbots massacred. Soon after it came to be under their settled dominion, together with the rest of th

Western Isles. As these barbarians held learning in no estimation, the college of Iona, though it continued to exist, began to decline, and had its connexion with Britain and Ireland in a great measure cut off. Dunkeld affected then for some time to be the primate's seat in Scotland, but did not long maintain its claim; for about the end of the ninth or beginning of the tenth century, the legend of St. Regulus and the apparition of St. Andrew was invented; in consequence of which St. Andrews came to be considered as the principal see of Scotland, and St. Andrew to be considered as the tutelar saint, instead of St. Columba.

"Still, however, the Culdees retained their influence and respect, and often elected the bishops of their bounds. At length, in the twelfth and thirteenth centuries, the Romish monks poured into the kingdom, supplanted the Culdees, and by degrees got possession of all their monasteries. The followers of St. Columba did not think it unlawful to marry and to take the charge of families as well as of parishes. The new monks, on the other hand, lived in celibacy, affected greater purity, and had more ceremony and show; so that the popular tide soon turned in their favour. The Culdees existed no longer in colleges, but for a long time after they continued to teach true Christianity apart." (*Life of St. Columba*, p. 162, 163.)

It is to the twelfth century that we must attribute the erection of those buildings in Iona which yet remain. The original structures appear to have been merely wattled huts, as was a general usage in Ireland and England at this early date; and it is very certain that the present buildings cannot reach higher than the time we have here assigned, because it is on record that the "Irish doctors" of this establishment united to pull down a stone church which had been erected by the Roman Catholic clergy in the twelfth century. The nunnery, which was erected for canonesses of St. Augustin, could not be of a higher date, though apparently among the oldest buildings there; as female establishments formed no part of the practices of the Culdees.

Great obscurity hangs over the establishment of bishops and bishoprics in Scotland. Though St. Columba was only an abbot, his jurisdiction extended over all the Irish churches, and he was, in fact, the primate of Ireland as well as of Scotland. In our own country, his command included Dunkeld, St. Andrews, Abernethy, and indeed all the other monasteries; and thus he held the sway even over bishops, as is remarked by our ecclesiastical historian Bede. The fact is, in this case, the terms bishop and abbot were frequently confounded at the beginning; and as abbeys were long prior to dioceses, the mystery appears easily solved. Abbots were frequently baronial sovereigns; and, in other cases, the terms were synonymous, or the abbots possessed the rank of the one, and the jurisdiction and office of the other. Nor was it uncommon, in the early ages of the church, to consecrate bishops who had no jurisdiction; while some bishops resigned their charges to found abbeys. As St. Columba is, by some of the early writers, called archbishop and pontifex, the superiority of his rank admits of no question, as these appellations were never bestowed on the inferior clergy.

The bishopric of St. Andrews is said to have been the first diocesan erection in Scotland, and to have been established by Grig. This date is remote, and it is certain that there were no regular dioceses in Scotland till long after. It is from the date of the arrival and establishment of the Romish clergy, that we must fix the regular state of the Scottish church. After the visit of the first papal legate Palladius, the sway of Rome commenced; and, in no long time, their victory was complete, though, as we just remarked, the Culdees were not totally abolished till the fourteenth century. In 1127, Gregory, abbot of the Culdees of Dunkeld, was made a bishop; and this is among the earliest of the regular creations that can be well ascertained. The authority of the pope now became gradually recognised, though the Scottish nobles and clergy long and often rebelled against foreign interference, and claimed the right of judging for themselves. The Romish power was scarcely complete, when it was for ever abolished by the Reformation.

Of Iona itself, as the most important establishment, we may here finally observe, that, in the time of Edward the First, and from the consequent annexation of the Isle of Man to England, the bishops of Iona became bishops of the isles, while those of Man retained the title of the Sudereys and Man; and that, in 1617, the diocese became confounded by James the Sixth with that of Argyll, its bishops becoming then resident in Lismore.

It was a part of the policy of the Popish clergy to gain influence by the establishment of monasteries, which should displace and suppress those of the Culdees. Monachism, before it was thus introduced into Scotland, had been known for several centuries in various nations of Europe. Anthony of Egypt is supposed to have been the author of this system. In 305, he thought it meritorious to forego the charities and sympathies of life, and to retire into the depths of the desert for the practice of austerity. His example was successively followed at Rome and in Pontus, and St. Martin of Tours, who flourished towards the end of the fourth century, was the first that founded a monastery in western Europe. Popish monasteries were not introduced into Scotland till early in the twelfth century; but before the year 1163, owing to the great encouragement given them by David I. they had become more common than in any country of Europe of equal extent and population. Owing to the blind devotion and munificence of nobles and princes, they continued to increase during the three subsequent centuries; and though Spottiswood states them as amounting only to 170, others with more truth have estimated them at nearly double that number. (*Life of Knox*, i. 348. Dalzell's *Fragments*, pp. 11, 12.) The number of monks in each establishment varied exceedingly. In 1542, there were 200 in Melrose alone; while in 1559 there were only eight in the Greyfriars at Perth. (Dalzell *ut Supra*. Knox, *Historie*, 128.)

It was the policy of the Popish clergy, whose influence and aggrandizement increased as ignorance and error prevailed, to extinguish, as far as possible, the illumination of the holy Scriptures, and to substitute the most absurd and impious doctrines, that their impostures might command the most implicit belief; and, to rivet the fetters of superstition, threatenings were denounced against those who presumed to disobey their mandates. Superstition and imposture had gained a great ascendency over the rude and ignorant Scots, and thus the clergy attained to an exorbitant degree of opulence and power, which necessarily corrupted their order, and debased the whole system of their religion.

The Scottish kings very soon demonstrated the undue influence which the clergy had acquired over them, by the vast additions which they made to their immunities and riches. The profuse piety of David the

First, transferred almost the whole crown lands to the church. The clergy were daily loaded with new possessions, until they became so powerful that they paid the full half of the national taxes. Their influence procured the erection of magnificent temples, and their opulence furnished them with showy apparatus for worship, which fascinated the senses, and imposed on the imaginations of the people. These nurseries of superstition and indolence universally degenerated, and became the notorious haunts of debauchery. Exempted from secular jurisdiction, and corrupted by wealth and idleness, the immoralities of the clergy were become a scandal to religion, and an outrage on decency. Though nominally separated from the world by the law of celibacy, the clergy of all ranks were shamefully profligate; the bishops openly kept their harlots, provided their sons with benefices, and married their daughters to the sons of the nobility and gentry.

The ignorance of the clergy respecting religion was as gross as their morals were dissolute. Until the reformed doctrines had made some progress, neither Greek nor Hebrew was taught in any seminary in Scotland. Even bishops were not ashamed to confess that they never read any part of the sacred Scriptures, except what they found in their missals. So ignorant were the clergy even on the continent, that they publicly accused Luther of composing a wicked book called the "New Testament," and inventing two new languages, the Greek and the Hebrew.

The harangues delivered for sermons by the monks were ludicrous and contemptible. They consisted of legendary tales concerning the founder of some religious order, his sanctity, the miracles that he performed, his watchings and combats with the devil, the virtues of charms, holy water, and the horrors of purgatory.

For many centuries before the Reformation, the necessity of an ecclesiastical reform was generally admitted by the Catholics themselves. In the thirteenth century, the preaching friars were instituted with the view of restoring that duty so generally neglected by the superior clergy, and of opposing the popular preaching of the Lollards, as the Jesuits were afterwards founded to oppose learning to the Protestants.

Waldus in the twelfth, Wickliff in the fourteenth, and Huss in the fifteenth century, inveighed with great boldness against the errors of popery. Their success in confuting these was complete; but being prosecuted, their followers were not numerous. The long and scandalous schism which divided the Romish church during the latter part of the fourteenth and the beginning of the fifteenth centuries, greatly diminished the popular veneration for the papal dignity.

In Scotland, at the end of James the Fifth's reign, the same contempt for the clerical authority and indifference to religion were universal. Few attended mass on Sundays, much less on other occasions; and of those who attended, some scoffed and behaved irreverently, while others busied themselves in merchandise even at the church porch.

While such a state of things could not well be contemplated without an eager desire for reformation, it should not be forgotten that the hand of an overruling providence was conspicuous in the combination and concurrence of circumstances, in raising up and qualifying zealous and resolute champions to bear witness to the truth, and suffer for its sake.

The most efficient cause was the translation of the Scriptures in the vernacular languages. By means of the art of printing, invented a short time before the Reformation, copies of the Scriptures were multiplied: and notwithstanding the clergy interdicted the perusal of the sacred volume, it was procured and read with great avidity. To the instruction derived from the Scriptures, and not to any injury offered to his order, must be ascribed the vigorous and unwearied exertions of Luther in exposing and combating the abominations of Rome. All Saxony, all Germany, all Europe, was in a short time filled with the voice of this bold reformer. He soon acquired the decided support of many of the German princes, who protected him from the vindictive policy of Rome and from the violence of imperial persecution. Before the name of Luther was known in Switzerland, Zuinglius had begun to explain the Scriptures to the people, and to censure the errors of the Romish church; and he actually called in question the supremacy of the pontiff before Luther ventured to attack any corruption except the sale of indulgences.

To prevent the dissemination of scriptural knowledge, the Catholic clergy employed every artifice and expedient: but their vigilance was unavailing; by means of the English merchants who traded to the continent, the Scots procured Tindal's translation of the Scriptures, with many Protestant books. The utmost circumspection in perusing them was indispensable; one copy of the Bible or of the New Testament supplied several families. The midnight hour was chosen for perusing the sacred oracles. When the trembling auditors were assembled, the Bible was brought from its concealment, and while one read, the rest listened with much attention. In this manner was knowledge diffused, at a period when there appears not to have been any public teacher of the truth in Scotland.

The reformed doctrines were early introduced into Scotland. John Resby and Peter Craw suffered martyrdom at St. Andrews about the end of the 14th century for exposing the absurdities of the Romish faith. And the inhabitants of Ayrshire, including most of those of high rank, having embraced reformed doctrines, were so formidable to the popish religion, so early as 1416, that it was enacted by the university of St. Andrews, that no person should obtain the degree of master of arts, unless he swore to resist all adherents of the sect of Lollards, the name by which the reformers were designated. Patrick Hamilton was brought to the stake in 1528; and the new opinions continued to gain ground so rapidly, that in 1559 the papal jurisdiction was abolished by act of parliament. A confession of faith drawn up by Knox and his brethren was passed by the same parliament; and the Protestant religion ratified as that of the state. At this period the form of ecclesiastical government was not minutely determined; but the presbyterian prevailed, as introduced by Knox from Geneva. In 1581, the presbytery of Edinburgh, the first in Scotland, was erected; and, in 1592, the presbyterian form of worship received the sanction of parliament. James VI. wishing to establish uniformity of religion in the northern and southern dominions, and disregarding the sentiments of his Scottish subjects, attempted to introduce episcopacy. But the modified species of episcopacy which he and his successor had established, was overthrown by the decisions of the famous presbytery held in Glasgow in 1638; decisions which were in the subsequent year confirmed by the Scottish parliament. Presbytery maintained its ground from this period till the restoration in 1660, when episcopacy again received the sanction of government; but after a violent and sanguinary struggle of twenty-eight years, the blackest period in Scottish history, it was finally triumphant, and established as it now stands in 1688, on the accession of William and Mary. The Westminster Confession of Faith was then received as the standard of the national creed; which all ministers, and principals and professors in universities are obliged to subscribe as the confession of the faith before receiving induction into office.

The church of Scotland is remarkable for its uncommon simplicity of worship; it possesses no liturgy, no altar, no instrumental music, no surplice, no fixed canonical vestment of any kind. It condemns the worship paid to saints, and it observes no festival days. Its ministers enjoy a parity of rank and of authority; it enforces that all ministers, being ambassadors of Christ, are equal in commission, that there is no order in the church as established by the Saviour, superior to presbyters, (πρεσβυτεροι,) and that bishop (επισκοπος) and presbyter, though different words, are of the same import. It acknowledges no earthly head: its judicatories are quite distinct from, and independent of, any civil judicatory; insomuch indeed that the decisions of the one are often contrary to those of the other, yet both remain unaffected and unaltered. When, for example, a clergyman has been presented to a parish by a patron, and induction and ordination have followed on that presentation, if afterwards it be found that the patron who had given the presentation has not that right, and that it belongs to another, the clergyman may be ejected as to all the temporalities of the office; but *quoad sacra*, he may continue minister of the parish, and exercise all the sacred functions: and though a new presentee may obtain a right to the civil endowments of the benefice, he can perform none of the sacred duties while the other chooses to avail himself of this privilege.

There are four ecclesiastical judicatories, namely, the Kirk Session, the Presbytery, the Synod, and the General Assembly, from each of which there is a power of appeal to the other; but the decision of the General Assembly is supreme.

The lowest court is the Kirk Session, which is composed of the minister of the parish, who is the moderator or president of it, and a number of the most grave and respectable laymen, members of the congregation. Their number varies in different parishes, five or six being about the average number, and their services are entirely gratuitous. They are something like church wardens in England, only they have a spiritual jurisdiction, as it is a part of their duty to visit the sick, &c. The Kirk Session takes cognisance of cases of scandal, such as fornication, sabbath-breaking, profane swearing. It also manages the funds of the poor, a duty in which it formerly was assisted by deacons, a class of men inferior to elders, as they had no spiritual jurisdiction, but not being found necessary, they are consequently disused.

The Presbytery, which is the court next in dignity, is composed of the ministers of a certain district, with an elder from each parish. The number of presbyteries is seventy-eight. Their chief duty consists in the management of such matters as concern the church within their respective bounds. But they may originate any matter, and bring it under the view of the Synod or General Assembly. They have also the superintendence of education within their bounds, such as the induction of teachers, and the examination of schools.

The Synod is the next intermediate court. There are fifteen synods, each consisting of the clergymen of a certain number of presbyteries, with elders as in presbyteries. Presbyteries meet generally once a month; synods twice a-year, though some remote synods, such as that of Argyle, only once.

The General Assembly is the last and supreme court, and meets yearly in the month of May in Edinburgh, and continues its sitting for twelve days. The king presides by his representative, who is always a nobleman, and is denominated *the Lord High Commissioner.* The General Assembly is a representative court, consisting of 200 members, representing presbyteries, and 156 elders representing burghs or presbyteries, and five ministers or elders representing universities,—making altogether 361 members. They choose a moderator or president, out of their own number, distinct from the Royal Commissioner, the duty of the latter consisting merely in convening and dissolving the court, and in forming the medium of communication between it and the throne. The moderator is now always a clergyman, though previously to 1688, laymen sometimes held that office.

The following Table explains the Ecclesiastical State of Scotland.

Synods.	Presbyteries.	Parishes.	Clergymen.
Lothian and Tweeddale ...	7	107	116
Merse and Tiviotdale........	6	66	66
Dumfries........................	5	53	54
Galloway........................	3	37	37
Glasgow and Ayr............	7	129	133
Perth and Stirling...........	5	81	82
Fife	4	66	71
Angus and Mearns..........	6	78	82
Aberdeen........................	8	97	100
Moray.............................	7	52	54
Ross...............................	3	23	23
Sutherland and Caithness...	3	23	23
Argyle............................	5	39	40
Glenelg...........................	5	29	29
Orkney and Shetland.......	4	29	30
15	78	910	940

The revenue of the clergy arises from tithes called teinds, and from glebe lands, the minimum extent of which is four acres of arable land, with as much pasture ground as will feed a horse and two cows. The greater part of the land of Scotland having been valued at a very remote period, the maximum of teinds for which they are liable was thus fixed and can never be augmented. The clergyman is not entitled to all the teinds of the parish; at least not without the sanction of the Court of Session, which, under the name of Court of Teinds, takes cognisance of such matters; but there is a power of appeal from its decisions to the House of Lords.

In some parishes the free teinds are so limited, that they do not in some instances amount to L.100, and in others not nearly that sum. This being much too small an income for the comfortable maintenance of a family, government, in 1810, enacted, that the minimum of stipend (in addition to the manse and glebe) should be L.150, and that the sum necessary to make up this income should be paid out of the treasury.

Statistics. Ecclesiastical state.

Out of 890 parishes, this augmentation takes place in the case of 172; and the sum required for this purpose is L.10,000 annually. There is very little inequality in the income of the Scottish clergy; few have an income of above L.350, while the average has been computed at L.285, including manse and glebe. In Greenock and North Leith, where the glebe has been feued, the income is much larger, the former of these yielding L.800, the latter L.1300. In large towns, also, the stipends are enlarged to meet the exigencies of the situation; and thus the ministers of Edinburgh enjoy a revenue of nearly L.700, varying a little according to the sources (an annual tax on house rent and duties connected with the port of Leith) from which it is collected.

In addition to parish churches, there are chapels-of-ease in large parishes where one church is insufficient; thus in St. Cuthbert's, or West Kirk parish, there are no less than three such chapels, the population being upwards of 40,000. The total number of such chapels is fifty-four. So early as the year 1709, a society was formed for promoting Religion and Education in the Highlands and Islands of Scotland. From the funds of this society, and from L.2,000 annually given by the king, missionaries, teachers, and catechists, are employed in these places. This has a most beneficial tendency, and will tend more than any other thing to the civilization and refinement of that part of the kingdom. By the bounty of government additional churches are about to be erected in large and populous parishes.

Dissenters in Scotland amount to about a fourth of the whole population. There are about 30,000 persons, representatives, as it were, of the Covenanters, in the reign of Charles II. who would not accept of the settlement of presbytery as fixed at the Revolution, and who are commonly termed Cameronians from the name of their famous leader. Almost all the dissenters are more rigid presbyterians than the members of the established church, and are all strict Calvinists. The following table gives a general view of the manner in which the inhabitants of Scotland may be arranged according to their religious opinions.

Table of Religious Opinions.

1. Members of the established church,	1,638,484
2. Seceders from the established church of various descriptions, but all holding presbyterian principals,	285,000
Total of Presbyterians,	1,923,484
3. Separatists, of various persuasions, as Baptists, Bereans, Glassites, Unitarians, &c.	50,000
4. Roman Catholics,	70,000
5. Scotch Episcopalians,	33,000
6. Church of England,	5,000
7. Methodists,	10,000
8. Quakers,	530
	2,092,014

The following table represents the state of the churches connected with the establishment, and also of the dissenting chapels at the end of 1825.

Chapels of ease in the church of Scotland		54
Churches in England in connexion with the church of Scotland, of whom nine clergymen are not licentiates of the church of Scotland		52
Churches in Ireland in connexion with the church of Scotland		1
Churches abroad in connexion with the church of Scotland.		
n Canada	10	
Nova Scotia	6	
New Brunswick	2	
New South Wales, &c.	7	
	25	25
Ministers of the church of Scotland on the Dutch establishment.		
Amsterdam	2	
Rotterdam	2	
Dordrecht	1	
Middleburg	1	
	6	6
Missionaries employed by the committee of General Assembly for managing the Royal Bounty		38
Missionaries employed by the Society for propagating Christian Knowledge		9

The following is a list of the synods of dissenters from the church of Scotland.

	No. of presbyteries.	No. of churches.
Reformed Presbyterian synod	3	28
The united associate synod of the secession church	19	333
Of whom there are out of Scotland, viz. at Newcastle	14	
London	7	
	21	
The associate synod	3	19
Original Burgher Associate Synod	5	50
The constitutional presbytery, or original Antiburghers	0	16
Relief synod	7	84
The Scottish Episcopal communion, six dioceses		65
Episcopal chapels in Scotland not connected with the Scottish Episcopal communion		6
Independent churches in connexion with the congregational union of Scotland		77
Total number of churches not in the establishment		868
From which deduct as in connexion with the church		185
Number of dissenting churches in Scotland		678
To which add the number of established clergymen		938
And the chapels of ease and missionaries		101
Total number of clergymen in Scotland, excepting Catholic clergymen, of whom there are no returns		1717

Though the established religion of Scotland is the reformed, there are still, as is evident from the preceding table, considerable remains of that ancient religion which has never adopted the sentiments of the reformers. The antiquity of the Catholics claims for them a distinct notice. And here we must separate the casual inhabitants following the Remish church, to bestow our attention on those who are the hereditary Catholics of

Scotland. The former consist chiefly, or rather solely of occasional Irish persons, generally labourers and mechanics, and are chiefly found in the populous towns of the west. In Glasgow alone they have been estimated at 10,000, and we need not name the conjectures and computations made of their numbers in Dumfries and the other towns which they frequent or inhabit.

As to the hereditary Catholics, their precise numbers are not known, but they are estimated by their own clergy as lying between 50,000 and 60,000. They are divided between several districts, where they have remained from the earliest separation of the churches; undergoing little or no change further than what has arisen from the progress of population and from emigration; and, speaking generally, the great mass is found among the Highlanders.

In the Western islands, Barra is so far Catholic, that it contains but very few Protestants; and the same religion is found in South Uist, Benbecula, and North Uist, more scantily further north, so as to comprise a considerable proportion of the population of the Long Island. In the inner islands, Egg and Canna are chiefly Catholic, as is Rum in part; but comparatively few are found in the other islands, and in many there are none at all. It is impossible to be very minute in these details.

On the western shore, the great centre of the Catholic population is a district which may be held to include Arasaig, Moidart, Morrer, Knoydart, and parts of Kintail, though the boundaries need not and cannot be accurately defined. Nor would it be easy to limit the exact places of those found in Ross and Inverness-shires, though here, Inverness itself, and Strathglas, may be considered as a sort of centre. In Argyleshire, Lismore is similarly the centre of Catholics, who are found in various places on this coast.

In the properly eastern Highlands, the chief mass is found about Tomantoule and Glen Livat, diverging in a scattered manner to the neighbouring country; and this enumeration is sufficiently accurate to give a general notion of the places of the Highland Catholics, though many are also found in certain parts of Perthshire, and elsewhere, which it would be tedious to indicate.

In Aberdeenshire, there is also a centre of Catholic population, which may be considered as including those who appertain to the shires of Banff and Moray, and the Catholic establishment of Auchcort may be considered as its centre. Thus Edinburgh may also be considered one, on account of its Catholic bishop; and it is quite superfluous to remark that some few are to be found in all the principal towns of the kingdom. Here, however, it is also proper to say, that the Catholic church of Scotland is chiefly confined to the inferior orders, though it must not be denied that several old opulent families, and among these two of the peerage, (Traquair and Newburgh) belong to it. It is also but justice to remark that the utmost harmony prevails when the two churches come into contact; that the Catholic people are among the most orderly and industrious of the population; and that no political or other grievances on this subject seem to be felt. The children of Catholics are in general educated at the parish schools; and in those parts of the Highlands where the Catholics are most numerous, few or none but Protestant teachers are employed, the adherents to both religions seeming equally anxious to avail themselves of the means of instruction put in their power.

The church government once included the celebrated foreign seminary of Douay, but its establishments for education are now confined to Scotland. Of these Lismore is the chief, and Auchcort the next, maintained chiefly by the produce of lands, and in the former case, by that of a manufactory of lime. Three bishops, *in partibus*, have the charge of as many diocesan divisions, of which Lismore and Auchcort are the places of two, and the third is located in Edinburgh. The priests are few in number, but found in the various places where the population of this persuasion is concentred; and hence the performance of their duties is necessarily deficient, as the remoter and scattered Catholics have little opportunity of profiting by their instructions, except under distant visitations.

As to the church revenue, we may say that is nothing; and from the poverty of the flocks, the office of priest is truly one of religion and of privation. There are no foreign grants for its maintenance. The property of Auchcort was held on a long lease which will shortly expire, and that of Lismore is scarcely sufficient to maintain its very limited college. A grant of L.1000 per annum, formerly given by our government, has been suppressed and not replaced; and the ministry has consequently nothing to depend on but the contribution of its flocks, which, from their general poverty, are necessarily small. A few small chapels in different places serve for the performance of the weekly or periodical duties; but in many of the islands and elsewhere, there is not even that accommodation.

CHAP. VII. STATE OF EDUCATION IN SCOTLAND.

State of education.

There is no country in the world where the establishments for the education of all ranks in society are placed on such an excellent footing.

It was enacted during the reign of William and Mary, that "there shall be a school and schoolmaster in every parish of Scotland," with a salary varying from 100 to 200 merks. In the year 1803, the limits of the salary were raised to 300 and 400 merks, or to £16, 13s. 4d. and £22, 4s. 5d. To this was added a dwelling house, having at least two apartments, and a quarter of an acre of ground for a garden. The proprietors of land in the parish are assessed for these expences and for that of the school-house. Half of the salary, however, is paid by the tenants, and the other half by the proprietors. At those schools are taught reading, writing, arithmetic, and in general the Greek and Latin classics, French, geography, land-surveying, and the elements of mathematics. The fees in the country parishes vary from 1s. 6d. to 5s. per quarter. In towns and villages many of the teachers of the parish schools have evening schools, at which mechanics and other labourers have been long taught arithmetic, practical geometry, and other useful branches of knowledge.

Provision being thus made by act of Parliament for the support of a school in every parish in Scotland, every parish possesses one; and as all the schools are placed under the inspection of a *resident clergy*, being annually visited and examined by the presbytery within whose bounds they lie, Scotland possesses a system of instruction which cannot be obtained in any other country where the clergy are not compelled to residence. A very great number of the schoolmasters in the country parishes in Scotland are young men who are either students in divinity, or preachers of the gospel, and whose minds are deeply imbued

State of Education.

with all the learning and science of the times, and from this cause there is a good understanding between the parochial schoolmaster and the established clergy, which produces the happiest results.

With such establishments for education it is not to be wondered at that it is scarcely possible in the lowland districts of Scotland to find a man who is not able to read, write, and count, and there are very few who cannot write and read.

In the highland districts, however, but particularly in the islands, the parishes are of such extent that it is impossible for the inhabitants to avail themselves of the parish schools, and consequently the people in these districts are instructed in a very inferior degree to the lowlanders.

This great evil has been to a considerable extent remedied by the *Society for Propagating Christian Knowledge*, who have established missionaries, catechists, and schoolmasters in these benighted districts. In order to promote the same object, the king presents to the General Assembly every year the sum of £2000.

As the funds, however, and consequently the exertions, of this society are greatly limited, the state of education in the Highlands and Islands of Scotland became lately a subject of general interest.

In 1824, the General Assembly appointed a committee to enquire into the existing means of education and religious instruction throughout Scotland. This committee transmitted to each of the ministers of the 907 parishes a list of queries, in order to ascertain the facts of the case. They received in the course of the year 800 returns, and from a statement which they have published in 1825, we have taken the following abridged view of the leading facts.

"The whole population of Scotland amounts to 2,093,856, and the church is divided into 16 synods.

In the ten synods of Lothian and Tweeddale, Merse and Tiviotdale, Dumfries, Galloway, Glasgow and Ayr, Perth and Stirling, Fife, Angus and Mearns, Aberdeen, and Moray, there are 764 parishes, and 1,716,126 persons, and so abundant is the number of schools in these districts, that, with a few exceptions, they may be said to be well supplied with the means of education, and there is scarcely an individual who has not been taught to read.

The remaining six synods, however, namely Argyle, Glenelg, Ross, Sutherland and Caithness, Orkney, and Shetland, situate chiefly in the Highlands and Islands, and containing only 143 parishes, and a population of 377,730 persons, are, as stated in the parochial returns, in the most urgent need of not less than 250 additional schools.

The number of scholars that would attend each of these 250 schools, it is computed, at a low average, would amount to 42. It follows, therefore, that in these synods there are 10,500 children left without the means of any education; and the committee are quite satisfied, that the number is, in fact, *much greater* than the calculated number of 10,500.

These 10,500 children alluded to, are all, it is to be noticed, under 15 years of age. If persons of all ages are included, the number of those not taught to read almost exceeds belief. But how could it be otherwise, when more parishes than one are described as not having a sufficient number of schools to accommodate one-tenth of their population? Several are said to be in need of three and four, and one of even six schools; and as to another, the fact is mentioned, that it consists of 1000 square miles, and has a population of 4747 souls, and that of these only 995 have learned to read at all.

In the first ten synods above mentioned, there are only six catechists stated to be necessary for the due means of religious instruction to the people, and this necessity arises from the large territorial extent of some particular parishes.

In the other six synods also above mentioned, no fewer than 130 catechists are required! Nor will this deficiency seem surprising, when the physical localities of the country are considered. There are many islands in it at great distances from the coast. The coast of the mainland is often indented by long arms of the sea; and its whole surface is intersected, and in many places rendered impassable, by precipitous mountains, and by rapid rivers.

One parish, seventeen miles long, on the mainland, has an island belonging to it with a population of 300, situate at 24 miles from the shore, and owing to its great distance, and a dangerous navigation intervening, the minister cannot visit it above once in the year. Another parish consists of nine islands, of which six are inhabited, and it extends, including sea, 50 miles in length, and 30 in breadth; and a third parish of 24 miles long on the mainland, includes four inhabited islands, some of which are twenty miles distant from each other.

Each of these parishes has only the parochial minister to perform every pastoral spiritual duty to the people."

The general instruction of the people of Scotland is greatly promoted by Sunday schools,* which are established in many of the parishes and villages; and several of these have libraries consisting of books easily understood, which are lent out to the children.

Besides the parochial schools and those established by the Society above mentioned, there are many private schools in every part of the country, which are supported solely by the fees of the pupils, and some of which are taught by women.

In the principal burghs and provincial towns of Scotland, where the parochial schools are of a higher description, they have been distinguished by the name of *Grammar Schools*, and the title of rector has by courtesy been given to the master. At such schools there is generally provision for accommodating a number of boarders; and the education which they afford is of the very best description.

Within the last 20 years another kind of establishment has arisen in some of the larger provincial towns called *Academies*. These institutions, sometimes under the direct patronage of the magistrates; and sometimes under that of subscribers, are taught by a rector and several subordinate masters. They exist at Annan, Ayr, Cupar, Dundee, Inverness, Montrose, Perth, Tain, and several of them have been described in our accounts of these towns.

Scotland possesses four universities, viz.

		Founded in.	Principals.	Professors.
St. Andrews,		1412	2	11
Glasgow,		1450	1	19
Aberdeen	King's College	1404	1	9
	Marischal College	1593	1	10
Edinburgh,		1581	1	28
			6	77

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* In 1818, these schools amounted to 500.

Statistics.

A detailed account of these different universities has already been given, under our articles, ABERDEEN, ANDREWS ST., EDINBURGH, and GLASGOW.

The following table shows the number of students that matriculated at the university of Edinburgh, at different times from 1791-2 to 1824-5.

	Students.		Students.
1791-2	1279	1820-21	2116
1795-4	1218	1821-2	2181
1799-1800	1330	1822-3	2344
1805-6	1570	1823-4	2273
1809-10	1980	1824-5	2198
1815-16	2097	1825-6	See below.

In the year 1824-5, the following students matriculated.

Literature,	777
Medicine,	939
Law,	233
Divinity,	249
Total	2198

In 1825-6, there were enrolled at the college,

Students in Medicine,	854
Literature,	809
Law,	298
Divinity,	Not yet returned.

The following students obtained the degree of Doctor of Medicine during ten years, from 1811 to 1820.

1811	44	1816	75
1812	58	1817	92
1813	62	1818	103
1814	88	1819	119
1815	82	1820	121

Annual average, from 1821 to 1824,	416
On August 1st, 1825,	140
Total number of graduates, from 1726 to 1825 inclusive,	3070

CHAP. VIII. ON ESTABLISHMENTS FOR PROMOTING THE USEFUL AND THE FINE ARTS.

On establishments for promoting the useful and the fine arts.

In various parts of this work, particularly in our descriptions of the counties of Scotland, we have given an account of various local establishments for the promotion of agriculture* and other useful objects. Under the present head, therefore, we shall confine ourselves to a notice of those institutions that have been established in Edinburgh, as the metropolis of Scotland, and which extend their benefits to every part of the kingdom.

One of the oldest and most important of these institutions is the Board of Trustees for promoting Trade and Manufactures in Scotland. This board was established by act of Parliament in 1726, for the purpose of regulating and improving the linen and hemp manufactures in Scotland. The objects which this board had in view were; 1, To promote by premiums the cultivation of flax; 2, To assist in the erection of lint mills; 3, To employ spinning mistresses in small towns and villages; 4, To confer premiums on the best specimen; 5, To give their aid in the formation of bleachfields, and in erecting the requisite machinery; 6, To furnish looms of superior construction to skilful and industrious weavers; 7, To promote improvement in the patterns of damask table linen; and 8, To bestow premiums on the best specimens of various kinds of linen cloth of Scottish manufacture, brought forward at a general competition which takes place annually in Edinburgh. The expence of carrying through these important objects, has been stated as follows:

For the growth of flax and hemp,	£2,000
For instructing persons to raise and dress flax,	80
For lint mills,	250
For the distribution of heckles,	160
For encouraging the spinning and weaving of linen yarn,	150
For bleachfields and bleaching machinery,	190
Wages for best specimens of linen cloth,	300
For improved patterns of damask table linen,	50
Total expences	£3,180

It is also a part of the duty of this board to affix a public stamp to all the linen made for sale in Scotland, in order to indicate its quality and good workmanship; but the competition of several manufacturers has rendered this unnecessary, and it has accordingly been discontinued since the year 1822.

Highland Society of Scotland, 1784.

The Highland Society of Scotland was established in 1784, and incorporated by royal charter in 1787. The object of this society is to promote the agriculture and internal improvement of Scotland in general. It is supported entirely by the contributions of its members, who in 1826 amounted to nearly 1700. It expends annually in premiums a sum of nearly £1300, and it has done more for promoting the internal improvement of the country than any other establishment in Scotland. The society has published *six* 8vo. volumes of transactions, and has recently erected in Albyn Place a splendid house, at which their meetings are held, and in which the secretary resides.

About the middle of the last century an attempt was made by several public spirited individuals in Edinburgh to establish a society for promoting the advancement of the useful arts, under the title of the *Edinburgh Society for the Encouragement of Arts, Sciences, Manufactures, and Agriculture*, but it does not seem ever to have been constituted. This society printed their regulations in a pamphlet of thirty-two pages, but without a date. The ordinary managers were Lord Deskford, Lord Dalmenie, Sir Alexander Dick, Sir David Dalrymple, George Clerk, Esq. Alexander Munro, Esq. Dr. Robert Whytt, Mr. J. Johnston, and Mr. Alexander Wedderburn. The extraordinary managers were the Duke of Hamilton, Earl of Glasgow, Lord Elibank, Lord Kames, Provost Drummond, Colonel Crighton, Andrew Pringle, Esq. Gilbert Elliot, Esq. Alexander Tait, Esq. Adam Fairholme, Esq. treasurer, Patrick Duff, Esq. secretary.

Society of Arts, 1819.

Towards the end of the year 1819, a society was formed for promoting the useful arts in Scotland, and has since that time been in active operation. It consists now of more than 200 members, each of whom contributes a guinea annually to the funds of the institution, or pays a composition of £10. 10s. It has also a class of honorary members not resident in Scotland, and of associates who reside in Scotland. The society holds regular sittings during the winter and spring months, which take place on the first and third Tuesdays of each month, at which papers on the useful arts are read and discussed, and models and machines submitted to the inspection of the members. The society has already rewarded several valuable inventions by the adjudication of gold and silver medals, and promises to be of extensive use in stimulating and directing that ingenuity which prevails in so remarkable a degree in this country. The Society of Arts proposes also to have biennial exhibitions of inventions, models of machines, and

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* In 1814 there were *fifty-seven* agricultural societies in Scotland.

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Establishments for promoting the useful and the fine arts.

of the productions of domestic and foreign industry, the first of which will take place in Edinburgh in the month of May, 1827.

Among the objects of this society there is one which promises to be of extensive use to Scotland, namely, to investigate all those natural productions of the country which are connected with the useful arts and which have been most unaccountably overlooked. A systematic attempt will be made to explain the hidden treasures of our mountains and valleys, and the advantages of such an examination cannot be more strongly pointed out than by briefly mentioning Dr. Hibbert's discovery in Shetland, of masses of chromate of iron, a rare and valuable ore, which Europe formerly imported from North America, and which is now an article of active traffic between Shetland and the most distant countries of Europe.

Institution for promoting the fine arts, 1818.

Till within these few years the cultivation of the fine arts in Scotland had been left to urge its way, by the efforts of individual enterprise alone, aided by the scanty protection of a very limited individual patronage. An attempt, however, was made early in the year 1818, to extend somewhat of national patronage to those engaged in its professional pursuits, by an association of those noblemen and gentlemen who were disposed to assist the advancement of the fine arts in this portion of the empire. Originating from the same motives which had given rise to the British Institution, and having the same patriotic and extensive objects in view, namely, the promotion in general of art, and the consequent benefit of artists, the association was established on the 15th April 1818, with the title of "The Institution for the Encouragement of the Fine Arts in Scotland."

The names of most of the principal nobility and gentlemen of Scotland were soon added to the list of members, of whom the greater part, exceeding 100 in number, became life governors, by payment into the funds of the institution of a certain amount of contribution. And to complete its auspicious establishment his majesty graciously signified his pleasure to honour the institution by becoming its patron and president. Very distinguished success has hitherto attended the exertions of this establishment, conducted by a committee of eight directors, with a treasurer, honorary and assistant secretaries, and a manager. Six public exhibitions have already taken place under their auspices; two consisting of the works of ancient masters alone, and four of those of the living artists of the united kingdom. And the satisfaction expressed on these occasions by the public, together with the increasing demand for works of art, which evinces itself in the annually increasing amount of purchases effected at these exhibitions, sufficiently prove their utility. A very elegant structure, comprehending an ample suit of galleries and accommodations for the Institution has been lately erected in a style suitable to the extensive objects contemplated, and was opened on the 13th of February 1826, on which occasion the Institution gave an elegant entertainment to the principal inhabitants. Here the annual exhibitions of both classes will in future be displayed, that of the ancient school supplied by the liberality of proprietors of these valuable works, who thus contribute an important service to their country, in affording the means of improvement and diffusion of taste; the modern pictures consist of the works of existing British artists or others resident in Britain, accompanied by a note of the prices when intended for sale. The institution has already laid the foundation of a library of works connected with the fine arts which will be progressively augmented; it is intended besides to dedicate the funds (which are already respectable) to whatever may appear most conducive to the advancement of art, the encouragement of artists, and the necessary aid and protection to young aspirants in that study.

See our article EDINBURGH, for an account of various other societies and public institutions.

CHAP. IX. PUBLIC WORKS, &c.

Owing to her mountainous surface, and to the nature of her coasts, Scotland possesses many public works, which have been visited and admired by travellers of all nations. Many of these works are unique in point of magnitude and extent, and evince the munificence of the government, and the skill of our civil engineers. As these works have been fully described in other articles of this Encyclopedia, we shall now merely refer the reader to the different heads under which they have been given.

Bridges, } Stone and iron. See BRIDGE, Vol. IV.
Suspension. See SUSPENSION Bridge, Vol. XVIII.
Canals. See NAVIGATION Inland, Vol. XV.
Lighthouses. See LIGHTHOUSES, Vol. XIII.
Railways. See RAILWAYS, Vol. XVII.
Roads. See ROADS, Vol. XVII.

CHAP. X. ON THE CLIMATE OF SCOTLAND.

ALTHOUGH many meteorological registers have been kept in Scotland, and many observations made relative to the condition of its climate, yet it is by no means an easy task to give a comprehensive and satisfactory view of the subject. The early meteorological registers consisted of records of the temperature at hours of the day which were very unfit to give its mean temperature; and consequently the mean temperature of the year had been ascertained only in a very few places. These observers seem to have attached a particular interest to the observations of the highest and lowest temperatures, two elements which are of very little service in meteorological speculations.

There seems to be little doubt that the climate of Scotland was considerably milder in ancient times than it is at present; and indeed this appears to be true of all the western kingdoms of Europe. When Julius Cæsar landed in England on the 29th of August, according to Dr. Halley, he found that all the corns were reaped except in one district. Cæsar states that the climate of Britain was more temperate, and the cold less severe than in Gaul; and we read in Tacitus, that the sky was foul with continued rains and fogs, but that it was free from the rigours of cold. It is related by Flavius Vopiscus, in his Life of Probus, that the emperor gave permission to the Britains to raise vines and to manufacture wine; and Beda informs us that vineyards were cultivated in Britain.

It appears from the records of religious houses, that in the parish of Lesmahago in Lanarkshire, *wheat* was formerly paid as tythe from lands, whereas for several centuries back, its climate is scarcely fit for bringing oats to perfection. In the parish of Glenluce too, in Wigtonshire, 12 bolls of wheat and 12 bolls of barley were formerly paid in tythe by a farm, which, about 40 years ago, brought a rent of only £12.

An argument in favour of the deterioration of our climate, by no means devoid of plausibility, has been drawn from the inferior size of the wild animals that are now produced, and also of our vegetable productions; but as this is controversial ground, we shall not enter upon it any farther.

Mr. Aiton has ascribed the deterioration of the climate of Scotland to the immense accumulations of moss earth which have arisen from the demolition of forests since the invasion of the Romans. "Moss earth is peculiar to countries situated in a high latitude. It is produced by the accumulation of vegetable substances in a decayed and waste state. The bulk is increased gradually by the addition of vegetables of the mossy tribes which grow upon its surface. Of all other soils, peat earth absorbs and retains the greatest quantity of water; 32½ oz. of dry moss soil, will retain without fluidity 18 oz. of water; whilst 39 oz. of the richest garden mould will only retain 18¼ oz. Moss is also more retentive of cold than any other soil; frost is often found to continue in deep mosses till after the middle of summer. Hence the effects of mossy accumulations, in rendering the climate colder. The cold evaporations which arise from such immense tracts of the soil as exist, particularly in Scotland, chill the atmosphere, and increase the bleakness of the climate."*

In treating of the climate of Scotland, Dr. Graham of Aberfoyle, whose judicious selections from the Statistical Account we shall here make use of, divides it into three districts; 1. The west coast of Scotland from the south; 2. The middle zone, including the midland counties; and 3. The eastern coast of Scotland.

1. *Climate of the West Coast.*

The counties of Kirkcudbright and Wigton, on the south-west coast, enjoy a pure and salubrious air. The lower parts in particular have less rain than the more northern districts of the west coast, an effect which is probably produced by the shelter which it receives from Ireland. In the interior of Kirkcudbrightshire the frosts are sometimes intense, but the snow does not lie long. In Wigtonshire, the winters are very cold, and the air though moist is salubrious.

Ayrshire has a mild and temperate climate, but the air is very moist and damp. The westerly winds blow severely on the coast during the winter.

Renfrewshire is visited with frequent and heavy rains, and in Dumbartonshire, which has the same character, the rains which come from the south and south-east are accompanied with high winds.

Argyllshire is considered the most rainy county in Scotland, being exposed to the unbroken influence of the Atlantic. The vapours of the ocean are attracted by its lofty mountains, and the clouds discharge themselves in torrents on the valleys. In the district of Cowal, and probably over the whole county, "the face of the heavens is generally louring and cloudy; a serene sky is seldom to be seen. The winds, prevented from a free circulation, rush through the glens with irresistible violence; and, at the bottom of high hills, and in narrow valleys, the transitions from heat to cold are sudden and excessive." The winters are, for the most part, mild and temperate; but the summers are frequently rainy and cold. Frosts are not intense, nor do snows lie long.

Inverness-shire may perhaps be considered as in some parts sheltered by the lofty mountains of Skye, and by the Western Isles, which furnish a barrier against the ocean. In its eastern districts, "the air is dry and healthy." On the west coast, as might be expected, "the air is moist, and generally very cold; but so purified by storms, and kept in motion by rapid currents, that it is, upon the whole, clear and healthy."

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In the island of Skye, "from the height of the hills, and the proximity of the sea, the air seldom continues long of the same temperature; sometimes it is dry, oftener moist, and in the latter end of winter and beginning of spring, cold and piercing." The climate of the Western Isles is so stormy on the side that is exposed to the Atlantic, that the inhabitants chiefly reside on the eastern side, which is sheltered by the mountains.

In the western parts of Sutherlandshire, the climate is rainy, but not unhealthy. The rain continues not only for hours, but often for days, nay for weeks, if the wind blows from the west; if it veers to the south its continuance will not be long.

In the Orkney islands, the south-west wind blows with the greatest frequency and violence, and brings with it the heaviest rains. From the south-east, the winds are frequent, and sometimes stormy: these winds bring with them, in spring, summer, and harvest, when they most prevail, damp, moist, and foggy weather. The north, the north-east, and north-west winds bring dry and wholesome weather. Seldom do calms for any length of time prevail. The greatest quantity of rain falls upon the west coast of these islands, owing to the height of the mountains. It is calculated that 26 inches of rain, on an average, fall annually; but the amount is probably much more. Storms of snow are not frequent or heavy; and though they come with considerable violence from the north-west and south-east, snow does not lie long. Part of the month of June is here almost as cold as any of the winter months. For about two weeks or more, about the middle of that month, a strong and piercing wind blows from the north, sometimes accompanied with snow and hail showers. As soon as that period is past, warm showers succeed, which revive the herbage. The Orkneys, on the whole, enjoy a mild and moderate heat in summer. The range of the thermometer is from 25° to 27° of Fahrenheit: the medium heat is 45°. The range of the barometer is three inches.

The climate of the Zetland Isles may be presumed to resemble, in most respects, that of the Orkneys. Though the sky is inclement, and the air moist, the country is far from being unhealthy.

Upon the whole, it appears from this sketch of the climate of the western coast of Scotland, and its isles, that, though moist, it is mild and temperate. The frosts are not intense, and the snows do not lie long upon the ground. The west and south winds prevail, accompanied by frequent and heavy rains; but such a climate seems admirably suited, by Providence, to maintain a constant verdure in a soil, which is, for the most part, thin and porous: and thus the natural constitution of this zone seems to point out the pasturage of cattle and of sheep as the way in which it should be principally occupied.

2. *The Middle Zone, including the Midland Counties.*

The middle zone, including the midland counties.

This region of Scotland may be considered as comprehending the counties of Dumfries, Selkirk, Peebles,

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* See Aiton's *Treatise on Peat Moss*, and the *General Report of Scotland*, vol. iv. p. 152.

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Lanark, Linlithgow, together with the eastern part of Stirlingshire, Clackmannanshire, Perthshire, and a part of Inverness-shire.

Having entered so largely into the detail of those circumstances which distinguish the climate of the western coast, it may suffice to observe, in general, with regard to this middle region, that the rains are less frequent; that the violence of the winds, proceeding from the Atlantic, is abated by the interposition of the mountains, which give shelter from the west and south-west: and that, from these causes combined, the weather is, upon the whole, of a more *equable* tenor. At the same time, and upon these accounts, joined to the greater general elevation of this region above the level of the sea, the frosts are more intense and lasting; the snows lie longer upon the ground, and the climate is less mild than on the western coast.

In Dumfries-shire, the air is dry; the winter is stormy and cold; the winds high, and the rains, in many seasons, heavy, but seldom any continuation of snow. This county, as well as the stewartry of Kirkcudbright, and shire of Wigton, have a southern aspect.

In Peebles-shire, the air is in general dry and healthy; but in the higher parts of the county, it is for the most part moist.

Lanarkshire is situated so singularly, in general reference to this region, as to require more particular notice; and, fortunately, this notice is furnished, in a very superior style, by Mr. Naismith, the intelligent Reporter of Clydesdale. It is hoped that the reader will be gratified with a somewhat enlarged detail of the climate of this county.

Lanarkshire, with a great portion of Renfrewshire, affords the most remarkable instance in Scotland of an extended slope declining towards the *west*. On a smaller scale, the county of Dumfries has a southern aspect; and the stewartry of Kirkcudbright and shire of Wigton, have a similar aspect to the south. Ayrshire, as well as Lanarkshire, declines to the west. The greater part of the rest of Scotland forms, it is well known, an inclined plane towards the *east*. In this district, however, we have an example of a territory sloping towards the sea, from an elevation of 2368 feet above its level, and discharging its waters, by a great river, into the Atlantic. This is a circumstance which must, no doubt, be considered, as influencing the climate of this district: and it is presumed that this influence may be traced in Mr. Naismith's account.

The influence of the Atlantic predominates throughout the whole bounds of Lanarkshire; the winds blowing about two-thirds of the year from south-west and west. The easterly wind, which conveys *haars* from the German Sea, is interrupted by the hills on the east side of the county; so that the temperature is moderate. Intense frost seldom continues long; and long lying snows are rare. The clouds, in passing over the flat and lower parts of the county, often leave them dry, while they break in showers upon the higher ground, in the eastern and western districts.

The under stratum of most parts of this county being compact, and impermeable to water, the evaporation from the moist soil is great. When a course of dry weather to effect this evaporation does not take place in spring, the seed time is necessarily late, which is one great cause of the lateness of the harvest in many parts of Lanarkshire. This lateness is most remarkable on the higher grounds of the county, on account of the more general moistness of the air, and the greater frequency of rain.

The eastern district of Stirlingshire, together with Linlithgowshire, may be considered as partaking, with respect to climate, of the character of the eastern coast; yet on account of the narrowness of this part of the island, the influence of the Atlantic still predominates, producing a prevalence of south winds, with the most violent storms, and heaviest rains that affect this quarter. Even in the Stirlingshire carses, as well as in many other parts of the central division of Scotland, and in the whole of the western districts, the hedge-rows grow with a marked inclination towards the north-east. The air of the district is, in general, pure and salubrious, except where those thick vapours which have been already described as arising from the extensive mosses of the county, unfortunately prevail.

The western district of Stirlingshire partakes of the character of Dumbartonshire, and the western district of Perthshire, with regard to climate. The vicinity of the sea, and the height of the mountains, occasion frequent and heavy showers.

The climate of the mountainous districts of Perthshire is very variable. The lofty mountains of Menteith and Breadalbane attract the clouds, which sometimes burst in torrents upon the valleys: at the same time it would appear, that more rain falls upon the mountains than upon the valleys. At other times the clouds are frequently seen to take their course along the hills, bursting upon them in heavy showers, whilst the interjacent valleys enjoy serene weather. In the more central parts of Perthshire, snow lies long, and the frosts are often severe. Along the sides of rivers, blasting fogs, and hoar-frosts, are frequent and injurious. In the more easterly districts of the county, the climate is mild, and the air salubrious. The east and north-east winds in winter, bring snow, or rain, or mist, from the German Ocean, and occasion a depression of the animal spirits. In the lower grounds, these moist vapours, and the exhalations from deep and narrow valleys, sometimes occasion agues; but these are now less frequent, owing probably to the improved mode of cultivation which has been introduced.

On reaching the tract of the Caledonian canal, in the *Glenmore* or the great glen or dell of Scotland, this midland zone may be considered as terminated: that part of the island which lies to the north of this line becomes so narrow, that its climate may be arranged either under that of the western, or of the eastern zone, according to the situation of the place.

3. *The Climate of the Eastern Coast of Scotland.*

In general, the climate of the east coast is dry, pure, and salubrious. Agues are disappearing in Berwickshire, in consequence of draining and improving the surface. Easterly winds prevail, especially in April and May. In the Lothians and Fife, the climate is mild and temperate, considering the latitude in which these districts are situated. In Forfarshire, the heaviest rains come in autumn and winter from the south-east, attended by violent winds; but the air in general is dry and salubrious. In Kincardineshire, although the climate is generally dry, yet the corn is sometimes deeply injured by mildews, or sea fogs along the coast, while the interior parts remain uninjured. In Aberdeenshire, the equinoctial storms in harvest are occasionally injurious to the various crops of corn; though there are less severe frosts in that county in

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winter than even in Middlesex. In the maritime parts of Banffshire, and particularly on the sea-coast of Moray, the climate is remarkably mild. On the eastern coast of Inverness and Ross-shires, it is pure, and favourable to the raising of grain. And even at the extremity of the island, the climate is temperate in the maritime parts, and the great valley in Caithness, though the thermometer seldom rises high in that northern latitude.

The circumstance which more especially characterizes the climate of the eastern coast, is the frequency of fogs arising from the German Sea; and these, as has been already suggested, are occasioned by the greater degree of heat which takes place in that narrow ocean, compared with the Atlantic. A copious evaporation is the consequence, which, under the appellation of *eastern haars*, overspreads the adjacent coasts, proceeding westward, till they are interrupted by the high mountains which occupy the middle region of Scotland. The easterly winds which convey these exhalations, and which prevail chiefly in spring, and in the beginning of summer, are, at the same time, cold and piercing. They had passed over a wide continent, which had been covered during many previous months with snow, and have not had time to acquire warmth, from the narrow sea which they had passed over in their course.

These exhalations, accompanied by winds from the east or north-east prevail more or less along the whole eastern coast. The climate of the eastern coast of Scotland, however, more especially towards the south, is salubrious; and less rain falls, unquestionably, than on the west coast, or even in the midland region. Agues, which formerly prevailed on the eastern coast, from the combined influence of exhalations arising from the sea, and from ill cultivated and ill drained grounds, are now less frequent."

4. *Results of Meteorological Registers kept in Scotland.*

Having thus followed Dr. Graham in his general observations on the climate of Scotland, we shall proceed to lay before our readers an abstract of some of the principal meteorological observations that have been made in Scotland. These we shall arrange under the following heads.

1. Observations made with the rain gage, and on the proportion of fair and rainy days in the year.
2. Observations made with the barometer.
3. Observations on the temperature of springs.
4. Observations on the temperature of the atmosphere.
5. Observations on Winds.

1. *Observations made with the Rain Gage, and on the proportion of Fair and Rainy Days in the Year.*

The following table shows the quantity of rain which fell at Kinfauns Castle, in Lat. 56¼°, from 1813 to 1825 inclusive, 20 feet above the sea:

	Inches.
1813	17·33
1814	20·05
1815	24·20
1816	24·95
1817	31·01
1818	19.89
1819	28.60
1820	23·50
1821	29·00
1822	27.80
1823	33·45
1824	24·00
1825	23.90

Mean of thirteen years, 25.21 inches.

The following table shows the result of three rain gages placed at different heights and observed at Kinfauns Castle.

		Inches.	
1814.—1.	On a conical hill, 600 feet above the sea,	33·84	
	2. Centre of garden, 20 feet,	20·05	
	3. Kinfauns castle, 129 feet,	15·59	
	Average of the three rain gages,	——	23·61
1815.—No. 1.	As above,	45·70	
	2. Ditto,	24·20	
	3. Ditto,	18·00	
	Average,	——	29·30
1816.—No. 1.	As above,	52·43	
	2. Ditto,	24·95	
	3. Ditto,	19·61	
	Average,	——	32·33
1817.—No. 1.	As above,	44·4	
	2. Ditto,	31·0	
	3. Ditto,	23·56	
	Average,	——	32·99
1818.—No. 1.	As above.	31·10	
	2. Ditto,	28·07	
	3. Ditto,	17.89	
	Average,	——	26·35
1819.—No. 1.	As above,	22.36	
	2. Ditto,	28.60	
	3. Ditto,	30.20	
	Average,	——	27.05
1820.—No. 2.	As above,	23·5	
	3. Ditto,	18·5	
	Average,	——	21·0
1821.—No. 2.	As above,	21·18	
	3. Ditto,	29·00	
	Average.	——	25·09
1822.—No. 2.	As above,	27.80	
	3. Ditto,	20.22	
	Average,	——	24.01
1823.—No. 2.	As above,	33·45	
	3. Ditto,	26·31	
	Average,	——	29·88
1824.—No. 2.	As above,	20·18	
	3. Kinfauns new castle, 150 feet,	24·0	
	Average,	——	22·09
1825.—No. 2.	As above,	23·90	
	3. Square tower, 140 feet,	23·45	
	Average,	——	23·67

At Belmont in Strathmore, on an average of ten years, there fell	30·4
At Longforgan on the Tay, on an average of twelve years, there fell	24·5
At Barnton in Mid Lothian, there fell in 1808	23.6
—————— in 1809	26·7

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At Glasgow, on an average of thirty years,	29·6
At Peebles, on an average of fourteen years,	28·7
At Dalkeith, on an average of eight years,	22.6
At Duddingston, on an average of eight years,	25·7
At Mountstewart in Bute, on an average of seven years,	46.6
At Branxholm in Roxburghshire, on an average of five years,	31.3
At Langholm in Dumfries-shire, on an average of five years,	36.7
At Wool in Selkirkshire, on an average of four years,	32.9
At Bothwell, on an average of three years,	24.8
At Peterhead in Aberdeenshire, on an average of two years,	30.9
At Dumfries,	36.1
At Hawkhill near Edinburgh,	29.9
At Ditto, in 1776,	26.1
At Dundee, on an average of nine years,	22.

At Huntly Lodge there fell in

1821 last nine months	19½
1822	24.03
1823	27.80
1824	28.31
1825	24.03

Edinburgh, Canaan Cottage, Mr. Adie, 260 feet above sea, 1824,*			24.6
At Edinburgh, in	1794	Professor Playfair	28.7
———	1795		35.7
——— Botanic Garden, 1796, Dr. Rutherford,			19.4
At Edinburgh, in	1797	Professor Playfair	25.9
	1798		23.9
	1799		25.9

	1810.	1811.	1812.
	Inches.	Inches.	Inches.
At Edinburgh,	.	32.6	27.1
Bothwell Castle,	25.0	33.1	25.0
Glasgow,	21.4	27.8	22.8
Greenock,	.	.	30.9
Largs,	38.7	56.6	35.2
Gordon Castle,	25.9	31.3	30.8

At Carbeth in Stirlingshire, the following quantities of rain fell in the years 1815 to 1820:

	Inches.
1815	41.393
1816	38.589
1817	44.765
1818	41.387
1819	42.845
1820	40.621
1821	47.368
1823	45.478
Mean of eight years,	42.930

Proportion of fair and rainy days.

In the middle ward of Clydesdale, on an average of five years from 1768

The number of dry days was 280
——— of wet days was 85

and what is very remarkable, the very same numerical results were obtained in the same district during a period of other five years, beginning with 1788.

At Longforgan on the Tay, the following results are the average of twelve years' observations, beginning with 1785:

	Rain.	Snow.	Fair.
Days	111	24	230

At Belmont in Strathmore, the results of ten years' observations, beginning with 1781, give:

	Rain.	Snow.	Frost.	Fair.
Days	151	27	38	187

The following table shows the state of the weather in Banffshire in 1805 and 1808. Among the fair days are included those that are gloomy and foggy, and among the rainy days those that are showery.

	1805.			1808.		
	Fair.	Rain.	Snow.	Fair.	Rain.	Snow.
January,	23	4	3	9	10	12
February,	22	1	6	21	1	7
March,	24	3	4	24	1	6
April,	23	5	2	15	2	13
May,	17	11	3 hail	25	5	
June,	20	9	1 hail	23	7	
July,	19	12		18	13	
August,	22	9		16	15	
September,	17	13		13	15	2
October,	20	9	2	16	15	
November,	24	4	2	26	1	3
December,	21	4	6	17	5	9

The following is the distribution of fair and rainy days at Kinfauns:

	Rain or Snow. Days.	Fair.
1813	150	215
1814	150	215
1815	132	233
1816	132	234
1817	160	205
1818	160	205
1819	148	222
1820	147	219
1821	172	193
1822	155	210
1823	169	196
1824	148	218
1825	129	236
Mean of thirteen years,	150	215

At Drymen, in Stirlingshire, on an average of fourteen years, from 1795, there were

Days completely fair	158½
Days completely wet	34½
Days showery	171½
Days more or less rainy	205½

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* See Dr. Brewster's *Edinburgh Journal of Science*, No. I—VIII.

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The following general results have been given by Sir John Sinclair respecting the rain in the east and west coasts of Scotland.

	East Coast. Days.	*West Coast.* Days.	*Difference.*
1. Average number of days of rain and snow	135	205	70
2. Fair days	230	150	
	365	365	

2. *Observations made with the Barometer.*

		Inches.
At Longforgan, on the banks of the Tay, the greatest range of the barometer during eleven years, was		2.8
In the west of Stirlingshire, about seventy feet above the sea, the greatest range during a period of eleven years, was		2.8
In Orkney, the range of the barometer is said to be		3.0
The mean height of the barometer at Kinfauns, about twenty feet above the sea, from the beginning of 1815 to the middle of 1819, was		29.650
The mean height of the barometer at Gordon Castle, eighty feet above the level of the sea, for 1811, was		29.74
The mean height of the barometer at Belmont for three years, from 1790, was		29.59
Mean height of the barometer at Edinburgh, 265 feet above the level of the sea,		
8 A.M. 1794	Professor Playfair,	29.641
10 A.M. 1795		29.654
1796		29 613
260 feet above the sea, 10 A.M. 1824	Mr. Adie,	29.583
10 P.M. 1824		29.552

3. *On the Temperature of Springs.*

Edinburgh Crawley spring, 564 feet above the sea, Observed by Mr. Jardine,		46° 35
———— Black spring, 882 feet above the sea,		44 86
Temperature of springs near Edinburgh, according to Dr. Roebuck,		47
Rosebank near Perth, temperature of a pump well twenty-five feet deep, 1819,		45
Ditto ditto 1815,		45 4
Inverness, height 30 feet above the sea.		44 7
Huntly Lodge, 440 feet above the sea,	1821,	45
————	1822,	45 39
————	1823,	44 3
St. Andrews, 78 feet above the sea,	1821,	47 0
————	1822,	47 2
————	1823,	46 5
Thurston, 180 feet above the sea,	1821,	45 3
————	1822,	45 16
————	1823,	45 12
Auchenard, 515 feet above the sea,	1821,	45 7
————	1822,	46 0
————	1823,	44 1
Tweedsmuir, 1500 feet above the sea,	1821,	45 6
————	1822,	45 8
————	1823,	44 7
Leadhills,		44
Inchbonny, near Jedburgh,	1821,	45
Stowe, Mid Lothian,		45 5
Leith,	1821,	47 6
Wick, 45 feet above the sea,	1823,	44 4
Gordon Castle,	1817,	45 6
————	1818,	47 73
————	1819,	46 60

4. *Observations on the Temperature of the Atmosphere.*

Observations on the temperature of the atmosphere.

Till within the last ten years, very few registers of the thermometer were kept in Scotland. From most of those which were kept, the results were deduced on very erroneous principles; and in almost all of them the observations were made at hours, which did not give the mean temperature of the day. Such of our readers as wish to consult these tables, are referred to the *General Report of Scotland*, Vol. IV. p. 182: where they will find the leading results.

Hawkhill.

The earliest observations on temperature which seem to have been made with accuracy, are those taken at Hawkhill near Edinburgh. They were made at 8^h A.M. and 2^h P.M., but as these hours do not give the mean temperature of the day, but a result almost exactly 1° degree higher, we have added the corrected mean temperature.*

	Mean Temp. at 8h and 2h.	Corrected Mean Temp.
1772	47° 90	46 90
1773	48 36	47 37
1774	47 20	46 20
1775	49 59	48 59
Mean of four years,	48 26	47 26

Edinburgh.

The next series of good observations made in Scotland were those of Professor Playfair, from 1794 to 1799 inclusive, 265 feet above the sea; but as these observations were made at 8^h A. M. about 3^h the time of maximum heat, and about 10^h P. M. the time of maximum cold, a correction of 0° 35 requires to be applied to them. Mr. Playfair supposed that the mean temperature occurred about 8^h A. M. and that the greatest cold was about 10 P.M.; and hence he concluded, that by obtaining the mean of the maximum and minimum, and the general mean at 8, and by taking the mean of all three, he would get the mean temperature of the day. As the mean temperature, however, occurs at $9\frac{1}{4}^h$ A.M. and the minimum about 5^h A.M. it is obvious that the mean obtained by Professor Playfair must exceed the true mean.

	Mean Temperature of 8 h. A. M. 3 h. P. M. and 10 h. P. M.	Corrected Mean Temperature.
1794	50° 32	49° 97
1795	47 75	47 40
1796	48 10	47 75
1797	48 4	47 69
1798	49 28	48 93
1799	46 13	45 78
Mean of six years	48° 27	47° 92

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* This and other corrections applied above, are deduced from the hourly meteorological register kept at Leith, for the year 1824 and 1825. See the Transactions of the Royal Society of Edinburgh, Vol. X. Part II. now in the press.

Edinburgh.

We consider these results, even the corrected ones, as all too high, for reasons which have been explained in the *Edinburgh Transactions*, vol. ix. p. 209.

The following observations were made by Messrs. Miller and Adie, opticians, in Merchant Court, about 230 feet above the level of the sea.

	Mean Temperature.
1795 . . .	45°902
1796	46 432
1797 . . .	46 355
Mean of three years	46° 230

Gordon Castle.

A series of very excellent observations have been made at Gordon Castle, the seat of his Grace the Duke of Gordon, from 1782 to 1819. The observations were made at 8h A. M. and 3h P. M. two hours, one of which being very nearly the time of the mean, and the other that of the maximum, cannot give the mean temperature of the day. By applying, however, a correction of 1°.008, we obtain the following results:

Mean temperature at Gordon Castle for thirty-eight years, at 8h A. M. and 3h P. M.	47° 337
Correction	1 008
Corrected mean temperature .	46° 329

The latitude of Gordon Castle is 57° 38′, and the height of the thermometer 80 feet above the sea.

A regular meteorological register has been kept at Kinfauns Castle, the seat of the Right Hon. Lord Gray, since the year 1813, of which the following are the results:—From 1813 till 1820 inclusive, a correction of + 1° 11 is applied, as the mean of 8h A. M. and 10h P. M. is less by this quantity than the mean temperature of the day; and from 1821 to 1825, a correction of — 0° 12.

		Mean Temp.	Mean Temp. corrected.	Mean of Six's Therm.
1813	Mean of 8h A. M. and 10h P. M.	44° 96	46° 07	not observed.
1814	. . . . . .	43 69	44 80	
1815	. . . . . .	45 27	46 38	46° 46
1816	. . . . . .	43 10	44 21	44 65
1817	. . . . . .	44 65	45 76	46 75
1818	. . . . . .	45 01	46 22	47 74
1819	. . . . . .	45 27	46 38	47 22
1820	. . . . . .	45 02	46 13	46 74
1821	Mean of 10h A. M. and 10h P. M.	47 27	47 39	47 98
1822	. . . . . .	47 84	47 96	48 61
1823	. . . . . .	45 49	45 61	46 01
1824	. . . . . .	47 03	47 05	47 80
1825	. . . . . .	48 32	48 44	49 50
Mean of thirteen years' observations		45 61	46 35	47 22

Leadhills.

The following table shows the mean temperature at Leadhills, in Lat. 55° 25′, from 1811 to 1820, the thermometer having been observed at six in the morning, and one in the afternoon. These hours give a mean approaching very nearly to the mean temperature of the day. This mean requires a correction of only — 0° 12.

1811 Mean temperature, :	42° 25′
1812 . . .	42 46
1813 . . .	44 25
1814 . . .	42 83
1815 . . .	44 42
1816 . . .	42 92
1817 . . .	44 29
1818 . . .	45 83
1819 . . .	44 54
1820 . . .	44 42
Mean of ten years, .	43 82
Correction, . .	— 0 12
	43 70
Add for 1280 feet above the sea,	+ 1 95
Mean temperature reduced to the level of the sea, . . .	45 65

A regular meteorological register has been kept by Mr. Murdoch with great accuracy, since 1822, at Huntly Lodge, the seat of the Marquis of Huntly, by means of very nice instruments made by Mr. Adie. The following are the mean temperatures from 1821 to 1824 inclusive:

1821 . . .	45° 64
1822 . . .	46 96
1823 . . .	44 57
1824 . . .	46 54
Mean of four years,	45 93

Huntly Lodge is situated in North Lat. 57° 24′ and in West Long. 2° 57′, and 440 feet above the level of the sea.

About the year 1820, the Royal Society of Edinburgh requested various intelligent individuals to keep registers of the thermometer in various parts of Scotland. During the first year, viz. 1821, nearly sixty journals were regularly kept; but though they diminished considerably in subsequent years, yet the Society is now in possession of a rich series of observations made during five complete years, from 1821 to 1825 inclusive, the results of which will be published in the *Transactions* of that body.

The following are the general results of a very few of the registers kept in different parts of Scotland.

Statistics.
On the Climate of Scotland.

TABLE *showing the Mean Temperature of the Atmosphere and of Springs in different Parts of Scotland, in the Year* 1821.

Places.	Latitude.	Longitude.	Height above the Sea in Feet.	Distance from the Sea in Feet or Miles.	Mean Temp. of Springs or Wells.	Mean Temp. of the Air 10 A.M. and 10 P.M.	Winter Months.	Spring ditto.	Summer ditto.	Autumn ditto.
Light-House Start Post	59° 20′	2° 43′	90	300 feet.		47° 33	43° 33	43° 07	52° 29	49° 62
Ditto Sumburgh Head .	59 52	0 54 W.	335	385 feet.		45 5	40 08	43 29	50 63	47 48
Ditto Island Glass . .	57 27	6 36 W.	45	1000feet		47 39	41 54	44 71	54 77	48 58
Wick	58 28	41 0 W.				46 78	40 35	44 41	53 77	48 82
Inverness	57 29	4 12 W.	30	4800feet	44° 7	47 83	39 59	44 93	55 34	49 9
Huntly Lodge . . .	57 24	2 57 W.	440	13 miles.	45	45 64	36 27	43 65	54 25	48 37
Laurence-kirk . . .	56 40	2 16 W.	160	8 miles.		45 8	36 5	43 8	55 6	47 6
Kinfauns Castle . . .	56 23	3 12 W.	129	20 miles.		46	39 07	45 25	56 03	47 03
St. Andrews	56 20	2 49 W.	78	1050 feet	47	47 59	39 12	45 2	56 4	47 7
Light-House, Bell Rock	56 29	2 22 W.	81			48 65	42 91	44 34	54 69	52 69
Thurston	55 53	2 27 W.	280		45 3	47 9	41 9	44 8	55 7	49 4
Auchenard	55 52	0 25 W.	515	18 miles.	45 7	44 9	37	41 9	53 5	46 9
Stowe	55 40	2 52 W.	500	20 miles.		45 9	37 86	43 86	54 43	47 9
Thirlestane, Selkirkshire	55 26	3 09	650			44 9	36	42 3	54 3	47 3
Tweedsmuir	55 30	3 25	1300	30 miles.	45 6	44 7	36 17	42 97	54 6	46 43
Falla, Roxburghshire						43 3	34 85	41	51 5	48 81

TABLE *showing the Mean Temperature of the Atmosphere and of Springs in different Parts of Scotland, in the Year* 1822.

Places.	Mean Temp. of Springs.	Mean Temp. of the Air.	Winter.	Spring.	Summer.	Autumn.
Wick		47° 2	40° 1	45° 6	55° 3	48° 2
Inverness	44° 7	48 2	39 44	47 22	57 79	47 59
Huntly Lodge	45 39	46 96	37 6	46 88	56 62	46 69
Laurence-kirk		48 9	36 06	46 05	59 05	46 7
Kinfauns Castle		45 49	35 9	46 09	54 08	47 84
St. Andrews	47 2	48 4	39 5	47 35	58 56	48 4
Thurston	45 16	48 8	39 3	47 4	59 6	47 7
Auchenard	46	45 7	36 9	44 7	55 8	47 7
Stowe		46 31	36 3	48 22	57 46	46 27
Thirlestane, Selkirkshire . .		45 4	36 3	43 9	56 9	44 9
Tweedsmuir	45 8	46 1	36 9	45 1	56 9	46 1
Falla		44 1	36 3	42 3	56 3	44 3

Statistics.

On the Climate of Scotland.

TABLE *showing the Mean Temperature of the Atmosphere and of Springs in different Parts of Scotland in the Year* 1823.

Places.	Mean Temp. of Springs.	Temp. of the Air.	Winter.	Spring.	Summer.	Autumn.
Wick	44° 4	45°24	36°13	43°45	53°4	48°01
Inverness		45 77	35 65	44 78	54 19	48 43
Huntly Lodge	44 3	44 57	33 25	43 99	53 67	47 37
Kinfauns		44 93	34 45	48 91	54 86	46 7
Laurencekirk		45 7	35 59	44 49	54 08	48 72
Thurston	45 12	46 3	35	48 5	55 3	49 6
Auchenard	44 1	42 8	32 7	41 8	51 8	48 2
Stowe	4	43 97	33 27	42 87	54 87	45 08
Thirlestane, Selkirkshire .		43 7	35 3	41	52	46 5
Tweedsmuir	44 74	3 43	33 8	42 79	52 25	44 88
St. Andrews	46 5	46 49	36 18	45 11	55 93	48 75

TABLE *showing the Mean Temperature of the Atmosphere in different Parts of Scotland in the Year* 1824.

Places.	Temperature of Springs.	Temp. of the Atmosphere.	Winter.	Spring.	Summer.	Autumn.
Wick	...	44° 4	37° 08	41° 6	54° 5	44° 5
Inverness	...	44 87	38 3	42 1	55 8	43 3
Huntly Lodge	...	46 84	38 2	44 59	56 89	46 66
Laurencekirk	...	44 53	36 19	42 56	56 8	43 9
Kinfauns	...	47	39 8	44 6	56 8	46 8
Edinburgh, Mr. Adie . . .	...	46 65	39 58	44 28	55 71	46 87
Leith, hourly register . . .	...	47 81	40 67	44 6	57 24	47 91
Thurston	...	45 96	38 6	45 38	54 5	46 16
Stowe	...	44 19	37 03	40 59	54 55	44 6
Thirlestane	...	42 2	35 5	39	52	42 3
Tweedsmuir	...	43 53	36 2	40 19	54 05	43 71

The Royal Society of Edinburgh being desirous of determining the law of the daily progression of temperatures, succeeded in establishing at Leith Fort an hourly meteorological register, in which the thermometer is observed every hour of the day and night. This register has been kept during the years 1824 and 1825, and the results of it, which are very interesting, will be found in the *Transactions* of the Society, vol. x. part ii. or an abstract of them in Dr. Brewster's *Journal of Science*, No. VIII.

5. *Observations on Winds.*

The following comparative view of the winds on the east and west coast, has been given by Sir John Sinclair.

East Coast.

1. Blowing from the north . .	25 days.
2. From the north-east . .	29
3. From the east . . .	62
4. From the south-east . .	14
5. From the south . . .	9
6. From the south-west . .	105
7. From the west . . .	102
8. From the north-west . .	19
	365

West Coast.

1. Blowing from points from east to west by north . .	197 days.
2. From west to south . .	139
3. From south to east . .	29
	365

According to the observations of Professor Playfair, the state of the winds in 1795, were

		Days of West Wind.	Days of East Wind.
1795		231	134
1796	. . . .	253	110
1797	. . . .	256	109
1798	Fine season . .	250	115
1799	Unfavourable season	211	154

At Drymen, in Stirlingshire, on an average of fourteen years, from 1795, the winds were as follows:

Between North and East	105½
North and West	91½
South and East	29½
South and West	137

At Longforgan, on the Tay, the following are the average results of twelve years:

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Wind from the North	25
North-east	29
East	62
South-east	14
South	9
South-west	105
West	102
North-west	19
From Western semicircle	226
Eastern	139

In West Lothian in 1808, the winds were as follows:

From Westerly points	232
From Easterly do.	120
Due North . .	10
Due South . .	3

From the Belmont tables, the winds blew on an average of five years,

From the South-east nearly	88
South-west .	137

The following Table shows the state of the winds at Kinfauns, at 8 o'clock in the morning.

Direction of Winds.	1813	1814	1815	1816	1817	1818	1819	1820	1821	1822	1823	1824	1825
North and North-east .	10	3	9	32	25	19	28	19	10	11	4	15	9
East and South-east .	76	109	102	105	91	132	109	97	132	119	122	110	119
South and South-west .	101	65	85	62	133	93	60	67	45	68	59	55	95
West and North-west .	178	188	169	167	116	121	168	183	178	167	180	186	142

From the numbers in this Table, we obtain the following results for thirteen years:

North and North-east . .	15 days.
East and South-east . .	102
South and South-west . .	76
West and North-west . .	172
	365

Chap. X. On the Language, Literature, Arts and Sciences, Manners and Customs, Dress, Food, Antiquities, &c. of Scotland.

The inhabitants of Scotland speak three different languages, the English, the Scotch, and the Gaelic. The English language, whose origin we have already noticed in our article England,* is spoken by all well educated persons in every part of the kingdom. It is used in all written deeds, and in all works in prose. The Scotch language, which is used by all the lower class in the lowlands, and even by many old persons of the higher ranks, is still employed in our national poetry. The Gaelic language is spoken in every part of the Highlands; but almost all the Highlanders are acquainted with English, which is taught in all their schools.

The Scotch language, or that which is spoken in the lowlands of Scotland, has generally been regarded as a corrupt dialect of the English, or of the Anglo-Saxon; and those who have maintained this opinion, have not scrupled to fix upon some era at which it was imported from the south. Our eminent antiquarian, Dr. Jamieson,† however, who at first entertained this opinion, was led to investigate the subject with much attention, and the result of this investigation was, that the language of the lowlands of Scotland is as much a separate language as the English, and that its basis, like that of the English, is Teutonic, with a strong mixture of Gaelic and French. In order to establish this opinion, Dr. Jamieson contends that the Picts were a Teutonic race, who invaded Scotland about the same time that England was overrun by the Anglo-Saxons. They conquered and colonized, he conceives, the whole of the low country; while the Gaelic population, like the Welsh, sought for refuge amid the fastnesses of their mountains. Besides the evidence in favour of this opinion, drawn directly from history, Dr. Jamieson considers it as no inconsiderable proof, that the northern parts of Scotland were immediately peopled from the north of Europe by a Gothic race, that otherwise no satisfactory account can be given of the introduction of the Vulgar language. And he corroborates these views by facts connected with the history of the Orkney islands, and by arguments deduced from the architecture and customs of Scotland.

Considering the Scotch language, therefore, as separate from all others, it merits a degree of attention, to which, as a corrupt dialect of the English, it could never have been entitled; and we have no doubt that our readers will be gratified with the following ingenious observations upon it, which were published anonymously by one of the principal contributors to this work.

"Perhaps the chief causes which have tended to sink the estimation of the Scottish tongue, may be sought in the operation of that extensive principle, the association of ideas. The Scottish dialect is not now the language of the noble, the opulent, and the fashionable. It is no longer the style in which the transactions of public and of private business are conducted. It is but seldom and partially employed in conversation by the more enlightened and accomplished. It is heard chiefly from the mouths of the low, the illiterate, and the unpolished. It is unfortunately associated, therefore, with every thing relating to them; and indeed is too often contaminated and debased by their brutality, ignorance, and vice. In a different arrangement of things, however, very different ideas would, by the same principle, have been attached to it. When spoken by our independent and aspiring chieftains; when written by our men of genius and learning; and when pronounced by our beauteous queens and their attendant fair, its dignity was no doubt acknowledged, its vigour experienced, and its sweetness admired.

With this general principle of association other accidental circumstances have concurred; and, by their united agency, not only has the estimation of the Scottish dialect been diminished, but its own intrinsic worth also impaired: By men of real knowledge and classical taste it has very rarely been cultivated; and to the undirected attempts of less intelligent and polished minds, it has been almost entirely abandoned. From superior talents it has derived no improvement; and from celebrated names it has derived no support. Is it at all wonderful, then, that its culture should have languished, and its celebrity decayed?

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* Volume IX. p. 35.

† See the dissertation on the origin of the Scottish language, prefixed to Dr. Jamieson's *Etymological Dictionary of the Scottish Language.*

The indiscriminate use of Scottish terms and phrases by those who have composed in that dialect, may be considered as no inconsiderable cause of the decrease of its fame, and the depravation of its worth. When our vernacular tongue was the only language commonly spoken and written in the kingdom, a considerable diversity of diction would undoubtedly prevail. In it as in other languages, there would be certain epithets and expressions, certain colloquial and parenthetical phrases, employed by the lower classes, but proscribed in the circles of fashion and taste. There would, in short, be something of a polite and vulgar phraseology. But whether or not such a distinction ever existed in Scotland, it is evident that the present days of delicacy and refinement require some judgment and discretion in the application of words. Almost all our modern Scottish poets, however, have paid less attention to this circumstance than it deserved. They appear to have been more anxious to procure a collection of expressive vocables purely Scottish, than to cultivate elegance and delicacy of style. In this respect they have made little selection, but have promiscuously employed all the phraseology of the language: the vulgar, the ludicrous, and the indelicate, have been thrown into their compositions with an unsparing and undistinguishing hand. And this circumstance has probably contributed as much as any other to debase the poetry in general in the estimation of many; to stamp upon it a mark of coarseness and vulgarity; to burlesque the most tender sonnets, to offend the judicious taste, and disgust the delicate ear. In consequence of the long disuse of the language in fashionable life, it may indeed be difficult to ascertain exactly the more elegant diction; and perhaps in the present day, it may be regarded as trifling and absurd to speak of the pure and the polite as existing in the Scottish tongue. Some attempt at discrimination, however, may still be made. The more ancient Scottish writings may serve, in some degree, as guides and examples. For it is an undeniable fact, that in point of delicacy these are far superior to the compositions of later times. Indeed, after making allowances for the age in which they were written, they are rather remarkable in this respect.

The Scottish language appears, as was observed, to be possessed of recommendations which render it even in the present day neither unworthy of attention, nor incapable of improvement. It is not the language of an unlearned people. It is an incontestible fact, that at a very early period, classical literature was pretty generally cultivated in the court of Scotland. It is natural to conclude, that this circumstance must have tended considerably to improve the language of the country; and the conclusion is confirmed by the striking coincidence, which, in many instances, exists between the Scotch and the learned tongues; and there is perhaps no modern language into which the idioms of Greek and Roman writers can be more literally rendered, without impairing the sense of the original, than into that of the Scotch. The study of polite literature appears to have been in a more advanced state in Scotland some centuries ago than in many of the other countries of Europe. By those who have the opportunities of examining, and possess the power of judging, it is asserted that the letters and memorials of the Scottish princes are the finest compositions of the age in which they were written, and far superior in correctness, elegance, and arrangement, to those which were returned to them in answer. Now it is not a mere hypothetical deduction, that the language of the natives, in general, must have derived some improvement from the learning of the court. For it is known that Barbour, a Scottish historian, philosopher, and poet, though considerably prior in time to Chaucer, wrote in a style as pure, and a versification as harmonious as the English bard. The verse compositions of James I. and the publication of James VI. containing precepts for writing Scottish poetry; and the numerous collections of ancient productions in that dialect, which are still extant, furnish positive proofs that in Scotland, at an early period, attempts in verse were not only general and successful, but encouraged also by the patronage and example of the court.

In consequence of the long and intimate connexion which formerly subsisted betwixt the courts of France and Scotland, a considerable analogy between the languages was effected; and into that of the latter many of the terms and elegancies of the former have been introduced; examples of this are so numerous, that a selection would be difficult, and so manifest that it would be unnecessary.

The copiousness of the Scottish language in many respects is remarkable. But this consists not merely in an abundance of terms to express the same thing, but in the power which these terms possess, of placing the object in various points of light, and of remarking with precision a multitude of the minutest shades of difference. In consequence of this circumstance, with the power and permission of adopting, at pleasure, from the English, Scottish poets are furnished with a most extensive vocabulary, and enjoy very superior advantage for composing with ease, perspicuity, and richness of expression.

It contains a number of vocables peculiarly expressive, and purely its own. Many of these are monosyllables, and yet they convey an extent and an energy of meaning, which most of the modern languages can but imperfectly collect even by a circumlocution.

Its power of terminations, especially in diminutives, and the expression of endearment, is far from being inconsiderable, and, in many instances, it appears to be little inferior to that of the Italian.

It possesses a considerable portion of that rustic simplicity, so much admired in the Doric dialect of the Greeks, and not a little also of the smoothness and harmony of the Ionic. Like the former it drops final consonants, substitutes one for another, and converts many of the vowels and dipthongs of English vowels into A and I; and, like the latter, it delights to throw out the consonants, to produce a concourse of vowels, to soften the sound, and to promote the flow of those harsher terms which less easily combine in versification.

The Scottish language, in short, abounds in terms and phrases connected with domestic and social life, with rural scenery, sentiments, and occupations; and hence it is peculiarly fitted for pastoral poetry, the lighter odes, and the description of external nature. It surpasses in humorous representations, and is far from being unsuited to the plaintive and tender. The poems, and especially the songs of Burns, illustrate and confirm these observations. For the didactic and the sublimer kinds of poetry, it may be rather deficient in majesty and compass."

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The Gaelic language, or that spoken in the Highlands of Scotland, is a dialect of the Celtic, dialects of which are also spoken in Ireland, Wales, Bretagne, and the Spanish province of Biscay. Of all these the dialects of the Scots and the Irish are the most pure. That which is spoken in the north of Scotland is much more pure, and more abundant in primitives than that which was written some centuries ago, among the most unmixed part of the Irish nation. "A Scotsman, says Macpherson,[*] tolerably conversant in his own language, understands an Irish composition, from that derivative analogy which it has to the Gaelic of North Britain. An Irishman, on the other hand, without the aid of study, can never understand a composition in the Gaelic tongue. This affords a proof, that the Scots-Gaelic is the most original, and consequently the language of a more ancient and unmixed people."[†]

It would be inconsistent with the nature of a work like this, to attempt even the briefest sketch of the literary history of Scotland.[‡] We can afford room only for a few general remarks. There is scarcely a department in the wide field of learning and research, in which the Scotch have not been highly distinguished. In mathematical and physical science the names of James and David Gregory, of Maclaurin, Simpson, Black, Hutton, Robison, Playfair, and Ivory, will be long remembered. In the practical arts of civil engineering, the labours of Watt, Murdoch, Rennie, and Telford, will bear testimony to the remotest times of their pre-eminent talents. In history, Fordun, Buchanan, Robertson, Hume, Stuart, Ferguson, Watson, and Smollett, have shone forth with the highest lustre. Among our ethical writers may be enumerated Reid, Smith, Beattie, Oswald, Campbell, Lord Kames, Lord Monboddo, and Stewart; among our novellists, Smollett, Moore, Mackenzie, and Sir Walter Scott; among our anatomists and physicians, the Gregories and the Monroes; among our critics, Blair and Kames; among our antiquaries, Lord Hailes, Geddes, Pinkerton, Geo. Chalmers, and Dr. Jamieson; among our divines, Macknight, Blair, Logan, Moncreiff and Alison; among our painters, Runciman, Jamieson, Raeburn, Thomson, and Wilkie; and among our poets, Lermont, Barbour, Douglas, Ramsay, Thomson, Mallet, Armstrong, Arbuthnot, Mickle, Smollett, Beattie, Ferguson, Burns, Mackenzie, Baillie, Leyden, Scott, and Byron.

There are two events in the literary history of Scotland, which it is impossible to pass without notice, not only from the prominent place which they hold, but from the extensive and deep interest which they have excited in every part of the civilized world. The events to which we allude are the appearance of the poems of Ossian, and the novels of Sir Walter Scott. If the poems of Ossian are the productions of an ancient period, they cannot fail to be regarded with the most intense interest. If, on the contrary, they are the productions of a modern bard, Scotland has equal reason to be proud of having given him birth. Whether they are ancient or modern, they have been read with the deepest interest in every part of the world; they have been translated into all the languages of Europe, and the most distinguished critics have vied with each other in pointing out their beauties; while many of the most eminent poets have endeavoured in vain to imitate that pathos and wild sublimity by which they are so particularly characterised. Nor was this a transient effect produced by the blaze of their first appearance. After fifty years they have retained their popularity, and have acquired a permanent interest independent of the controversies to which they have given rise.[‖]

Novels of Sir Walter Scott.

The publication of the Waverley novels forms a singular feature in the literary history of Scotland. The fine sketches which they contain of the character and manners of the Scottish peasantry; the dramatic scenes which the author has sketched with such vivacity and richness of effect; and the purity of the Scottish language, with all the peculiar phraseology and idioms which are employed, have placed these works at the head of all others of the same class. But the singular feature in these works is that, like the poems of Ossian, though they are in a peculiar manner national works, conversant with our national history and local manners, yet they have acquired the character of European productions, which excite the same admiration in the most distant countries, where our history, our language, and our customs are unknown. The author has struck those chords of human feeling and sympathy which belong to man as an individual of the species, which no territorial limits can confine, and which no factitious institutions can impair. The German, the Frenchman, the Swiss, the Italian and the Spaniard, the Scandinavian and the Russian, weep over the sorrows of Ossian, and over the heroes of our Jacobite history, as if they had been the objects of their own national idolatry.

National character.

In national character the Scots hold a high rank. They are a grave, sober, sincere and religious people, and attached to their superiors, whether that superiority is derived from rank, wealth, official dignity, talents or virtue. Out of their own country they are peculiarly noted for their industry and enterprise, and few of them return till they have earned a competency to support them in their old age. Like the English, they are distinguished by their courage, by their love of domestic life, and by a contempt for every thing like show or theatrical effect. By their enemies, the Scotch have been considered as displaying a pliancy or servility of character; but if this remark is the result of observation and not of malignity, it must have been drawn from the study of that part of our population which have but recently escaped from the influence of feudal habits, or must have been witnessed in those districts where the power or kindness of the

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[*] Dissertation on the Poems of Ossian.

[†] An elaborate dictionary of the Gaelic language is now about to be published under the auspices of the Highland Society of Scotland.

[‡] To such of our readers as wish to study the literary history of Scotland, we would recommend the perusal of Dr. Irving's *Dissertation on the Literary History of Scotland* prefixed to his *Lives of the Scotish Poets.*

[‖] Those who consider these poems as modern productions, must entertain no ordinary opinion of the talents of the individual, who could compose the Gaelic originals of those poems from the original English, so that the most distinguished Gaelic scholars should prefer the translation to the original, and discover in it beauties which are entirely lost in the English version.

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chieftain still calls forth the humility or the affection of his vassals. In the lowlands of Scotland, the people have the same independence of character as the English, and we should be disposed to say, that the Scottish peasantry even surpass their neighbours in that respect, in so far as they surpass them in education and general knowledge, which are the sure foundation and the best tests of independence of character. There is nothing more characteristic of the Scottish peasantry than their respect for the Sabbath. In place of spending the Sabbath day in idleness and gaiety, the Scottish peasant accompanies his family to the house of prayer; and however small be his means, he appears in clean and decent attire. When the service is over, he instructs his children in the duties of religion, reads with them the holy scriptures, and perhaps accompanies them, when these duties are discharged, to some romantic and sequestered scenes, to contemplate the beauties of the material world. This observance of the Sabbath is no doubt the principal cause of the superior information and the sober and moral habits of the people.

Food.

In the lowlands of Scotland, the food of the people does not differ essentially from that of the English peasantry. Animal food is certainly less used than in England, and spirituous liquors are much more common. The lowland Scotch are now better lodged, their houses are kept with a greater degree of cleanliness, and if they do not in these respects rival their English neighbours, they are advancing towards them with accelerated steps. In the Highlands of Scotland, we regret to say, that the cottages are, generally speaking, of the worst description, and are as uncomfortable within as they are squalid without. The diet of the Highlanders is principally oatmeal, potatoes and milk; fish being much used on the coast.

Dress.

The dress of the lowlanders is the same as that of the English. In the Highlands, the bonnet, the hose, and kilt, and the plaid are still worn by the peasantry, and on many occasions by the gentry. The bonnet is made of sky blue felt; the kilt and the plaid are made of what is called *tartan*, which is a woollen stuff chequered with different colours, each clan having its tartan formed of a combination of colours peculiar to itself. The hose are stockings which do not reach the knee, and which are made of worsted chequered red and white.

Diseases.

The diseases most prevalent in Scotland, are consumption, rheumatism, the ague, fevers, the croup, and scrofula, &c. *Consumptions* are now more frequent than formerly among the young, and they carry off the greatest number about the middle period of life. This disease is said to have been formerly very rare, and seldom mortal. *Rheumatism*, which is now very prevalent in every part of Scotland, is said to have been but little known about eighty years ago. The *ague* was formerly prevalent over a large part of Scotland, but in consequence of the system of draining which has taken place, it has been entirely banished from many districts of the country. The *fevers* which prevailed in former times, were generally of the pleuritic and inflammatory species, but those of a low lingering and nervous kind are more prevalent. The *croup* is one of the most alarming of our diseases. It prevails chiefly near the sea, and is most frequent in damp situations, and rainy seasons. By the early application of leeches, and the use of calomel and emetics, it may be to a great degree prevented from assuming its severest form. *Scrofula*, which is an hereditary disease, is said to be very common, and to prevail chiefly in cold and damp places, and among people who live on poor diet, and principally vegetables.

Among the antiquities of Scotland, those of the Romans hold the most distinguished place. The principal of these are the celebrated wall built between the Firth of Forth and the Firth of Clyde, in the reign of Antoninus Pius, and in the remains of which many interesting inscriptions have been found.* The temple, called Arthur's Oon, a building of the same period, stood near the river Carron, about 1½ mile from Falkirk.† Roman camps and pillars are very numerous in different parts of Scotland. Some of them are remarkably entire, and they have all been described in our description of the counties of Scotland.‡ General Roy has followed the common opinion of antiquaries in ascribing those camps, &c. to Agricola, while Mr. Pinkerton is of opinion, that they may be more justly assigned to Lollius Urbicus, A. D. 140, but especially to the Emperor Severus, A. D. 207, who conducted two campaigns in Scotland. Constantine Chlorus, who is said to have made a long progress into Scotland in A. D. 306, had probably some share in the construction of the camps; and Statius informs us, that Bolanus erected several works in Britain. The most northerly of the Roman camps is near the source of the river Ythan in Aberdeenshire, and is about two English miles in circumference. A Roman station on a smaller scale has been discovered at Old Meldrum, a few miles to the south-east of the other.

Roman roads have been traced to a considerable distance in the east of Scotland as far as Forfarshire. A hypocaust was discovered near Perth and another near Musselburgh.

The Pictish monuments of Scotland had their origin in the 5th century; they are generally circular buildings, and whether they are found in the Highlands, the lowlands, or the Orkney Isles, they have been universally ascribed by tradition to the Picts. Dr. Jamieson divides them into two classes, viz. those above and those below ground. The first class includes their circular spires and castles, such as the cylindrical tower of Brechin and Abernethy‖ and the castle of Glenbeg in Inverness-shire. The class of subterraneous buildings, and those nearly underground, are generally of the tumular kind. Several of them are described by Pennant, and the greater part of them in the Statistical Account of Scotland. They are most numerous in Sutherland, Ross-shire, Orkney, and Shetland,§ where the Scandinavians are known to have had a permanent residence. These buildings are denominated Picts houses, duns and burghs.

The antiquities that seem to be of Danish origin may have originated in the ninth century. According to Pinkerton, they seem to have consisted of a vast hall, open to the sky in the centre, while the cavities in the wall formed recesses for beds. These buildings he considers as displaying the first elements of the Gothic castle. The engraved obelisks found at Forres, &c. have been ascribed to the Danish invaders; but Pinkerton regards them as more probably monuments of signal events erected by the kings or chiefs, so late as the fifteenth century.

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* A very minute account of this interesting specimen of Roman art will be found under our article ANTONINUS'S WALL, Vol II. p. 225.

† A full account of this Roman inscription will be found under our article ARTHUR'S OON, Vol. II. p. 523.

‡ Plans and drawings of the most interesting will be found in General Roy's Work.

‖ See our articles ABERNETHY and BRECHIN.

§ See *Statistical Account*, Vol. II. p. 56; III. 410, 543, 567; IV. 389, 390; X. 32, 304; XII. 163; XVI. 64.

The abbeys and castles erected since the time of Malcolm VI. are very numerous. The most splendid of the abbeys were founded by David I. in the twelfth century, such as Melrose, Jedburgh, Kelso, &c. an enumeration and description of which will be found under our article CIVIL ARCHITECTURE.

The most interesting remains of our Scottish antiquities are, perhaps, the *vitrified forts*, which Pinkerton considers to belong to the thirteenth century. We have already described them very fully in our article FORTS, *Vitrified*, and we may probably resume the subject under the word VITRIFIED *Forts*.

On the Language, Literature, Arts and Sciences, Antiquities, &c.

Parallel roads.

Among the antiquities of Scotland may be enumerated the parallel roads of Glenroy, because they have been supposed to be a work of art, and to have been formed by the Scottish kings. If we view them, on the contrary, as we do, as a natural phenomenon, and as the result of a great geological convulsion, they will possess a still higher interest, and be ranked among the most interesting phenomena in the history of our globe. See our article PARALLEL ROADS, where they are fully described, and the question of their origin minutely discussed.

For farther information respecting the antiquities of Scotland, the reader may consult Pennant's *Tour in Scotland*; General Roy's *Military Antiquities of the Romans in Britain*; King's *Monumenta Antiqua*; Pinkerton's *Inquiry into the History of Scotland*, 1789; the introduction to Dr. Jamieson's *Dictionary of the Scottish Language*; and Chalmers' *Caledonia*. Various minute descriptions of individual antiquities will be found in the different topographical articles in this work relative to Scotland.

GENERAL EXPLANATION

OF THE

PLATES BELONGING TO VOLUME SEVENTEENTH

OF THE

EDINBURGH ENCYCLOPÆDIA.

PLATE CCCCLXVII.

Contains Diagrams illustrative of the article PORISMS.

PLATE CCCCLXVIII.

Fig. 1. Common Printing Press.
Fig. 2, 3. Represent the Stanhope Press.
Fig. 4, 5. Show Ruthven's Printing Press.
Fig. 6. Clymer's Columbian Press.
Fig. 7. Barclay's American Press.
Fig 8. Wells' Printing Press.
Fig. 9, 10. Hope's Printing Press.
Fig. 11. Simple Copperplate Press.
Fig. 12. Shows the application of the wheel and pinion to drive the Rollers.
Fig. 13, 14. Mr. Lizars' Cast Iron Press.
Fig. 15, 16. Represent Perkin's Steel or Copperplate or Block Printing Press.

PLATE CCCCLXIX.

Fig. 1. Shows Messrs. Applegath and Cowper's double Printing Machine.
Fig. 2—10. Show Mr. Church's Type Founding and Printing Machinery.
Fig. 12. Represents Bacon and Donkin's Printing Machinery.

PLATE CCCCLXX.

Fig. 1—3. Show the Sucking Pump.
Fig. 4. The lifting Pump.
Fig. 5. The forcing Pump.
Fig. 6, 7. The forcing Pump with air vessels.
Fig. 8. Improved lifting Pump.
Fig. 9. Forcing Pump with solid plungers.
Fig. 10. Pump without friction.
Fig. 11. Haskins' Quicksilver Pump without suction.
Fig. 12. Dr. Robison's improvement on Garret's Pump without friction.
Fig. 13. Dr. Robison's occasional Pump.
Fig. 14. De la Hire's double forcing Pump.
Fig. 15. Centrifugal Pump.
Fig. 16. Smeaton's Pump for keeping up a constant head of Water.
Fig. 17. Pump with a double Piston.
Fig. 18. Three Barrelled Pump.
Fig. 19. Trevithick's temporary forcer.

PLATE CCCCLXXI. No. I.

Fig. 1, 2. Newenham's Fire Engine.
Fig. 3, 4. Another Fire Engine.
Fig. 5, 6. Perkin's new Hose for Fire Engines.
Fig. 7—10. Represent various Pumps by Ramelli and others.
Fig. 11. Brown's vacuum Engine.
Fig. 12. Mr. Hunter of Thurston's self-acting Pump.
Fig. 13. The Button or Tail Valve.
Fig. 14. The Spherical Valve.

PLATE CCCCLXXI. No. II.

Fig. 1—3. Represent Muschenbroek's Pyrometer.
Fig. 4. Shows Desagulier's improvements on it.
Fig. 5. Ellicott's Pyrometer.
Fig. 6, 7. Smeaton's Pyrometer.

Fig. 18. Is a new Compound Prism for Optical Experiments, proposed by Dr. Brewster.

Fig. 19. Is a Diagram for explaining the Optical Deception of Le Cat.

Fig. 20. Represents the Common Air Gun.

Figs. 21, 22. Is an Air Gun on an improved principle.

Figs. 23, 24, 25. Represent the Magazine Air Gun.

Figs. 26, 27. Show the ascending Snake put in Motion when placed on a Chimney-piece, by the Ascent of the Heated Air.

Fig. 28. Represents the Inflaming Condenser, in which a Piece of Amadou is set Fire to by the Heat generated by the Condensation of Air.

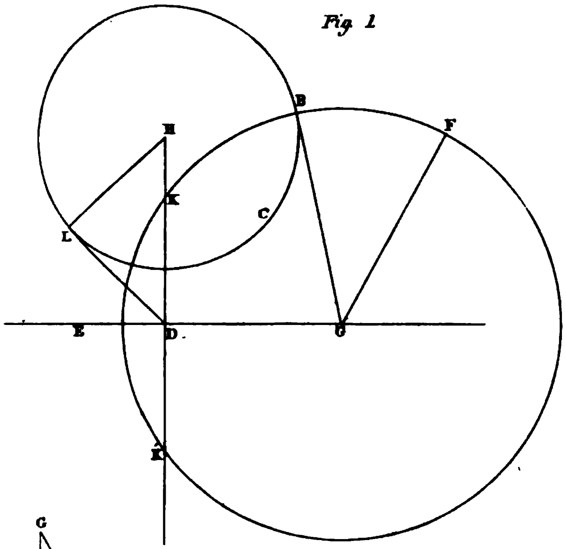
Fig. 29. Is a Representation of the Rotatory Gas Burner, which is put in motion by the reaction of the issuing Gas, and invented by Mr. John Nimmo, brassfounder, Edinburgh.

END OF VOLUME SEVENTEENTH.

EDINBURGH:
PRINTED BY A. BALFOUR AND CO.

PORISMS. *PLATE CCCCLXVII.*

Fig. 1



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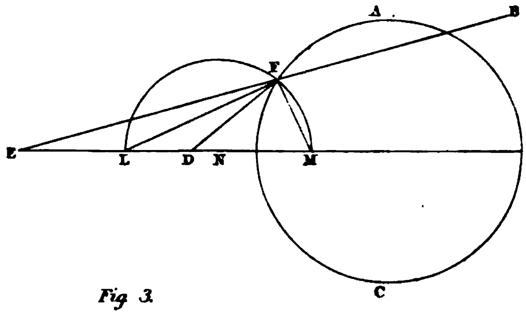

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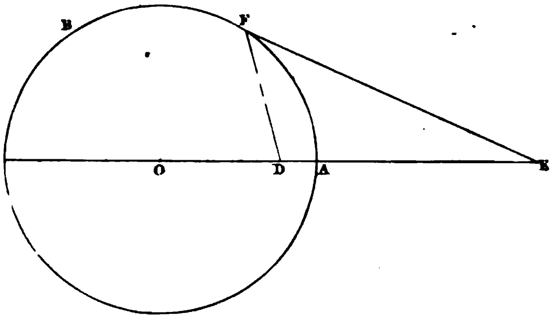

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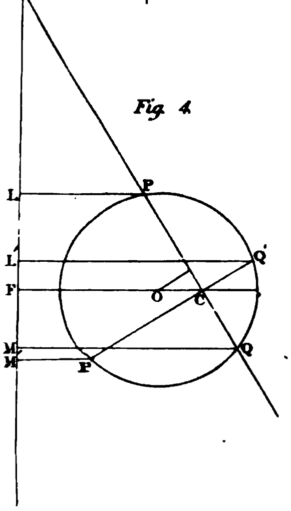

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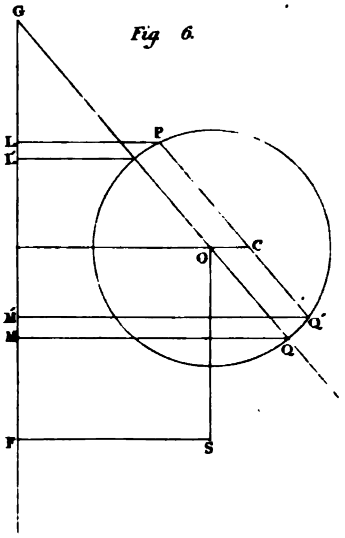

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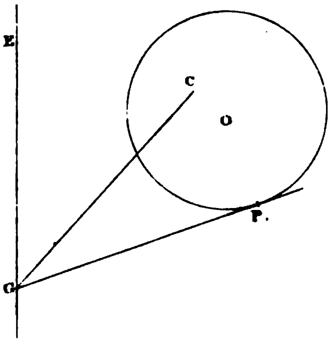

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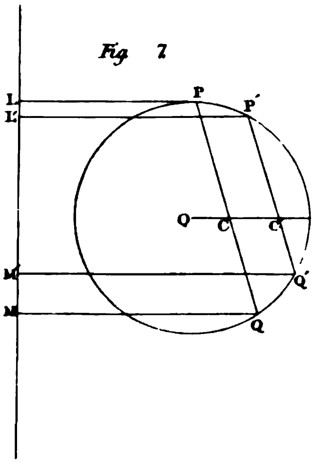

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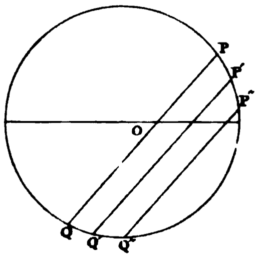

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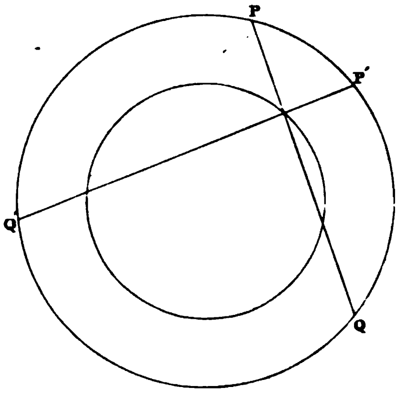
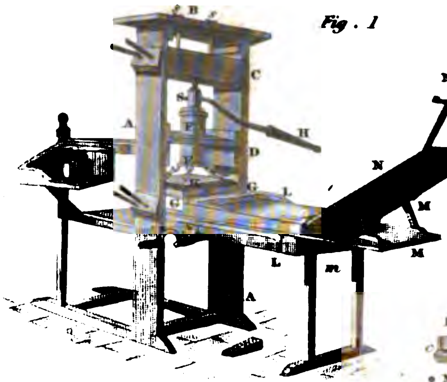


Drawn for the Edin^{r} Encyclopaedia

Engraved by J Moffat Edin^{r}

PRINTING PRESS PLATE CCCCLXVIII.

Fig. 1



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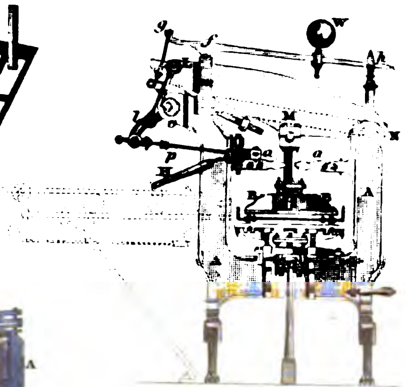

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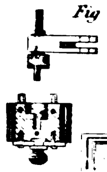

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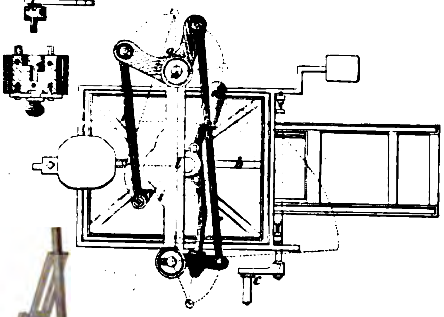

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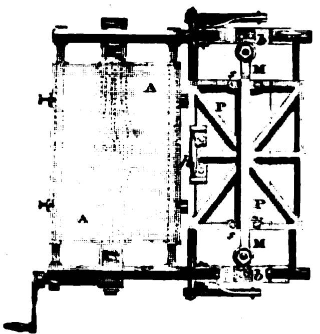

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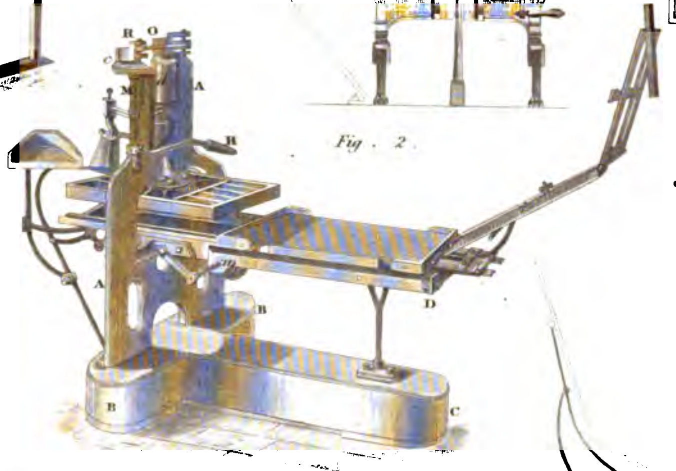

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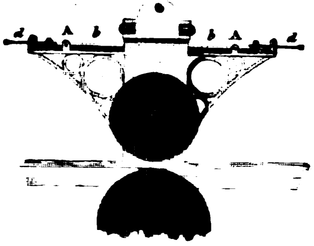

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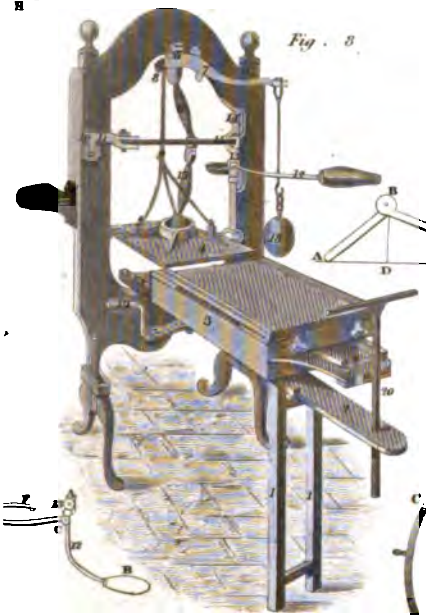

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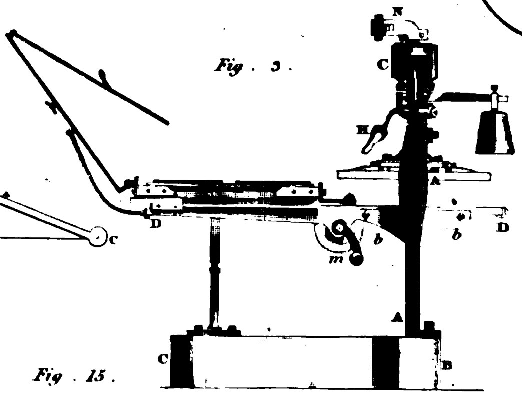

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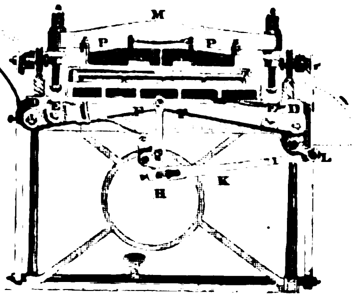

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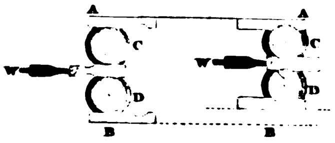

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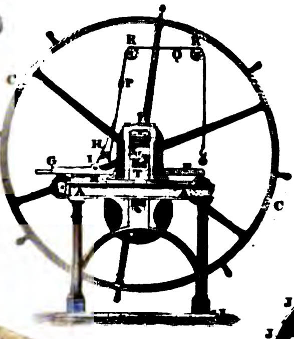

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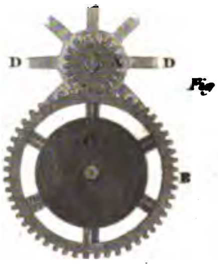

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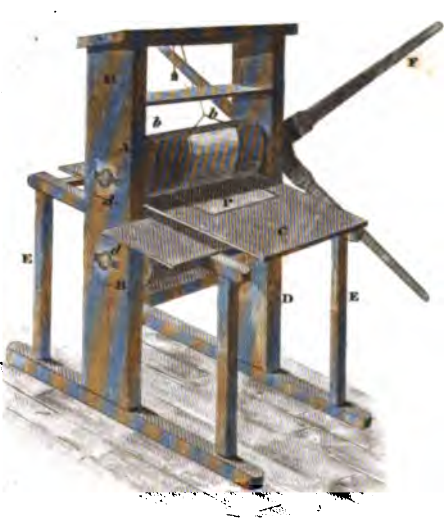

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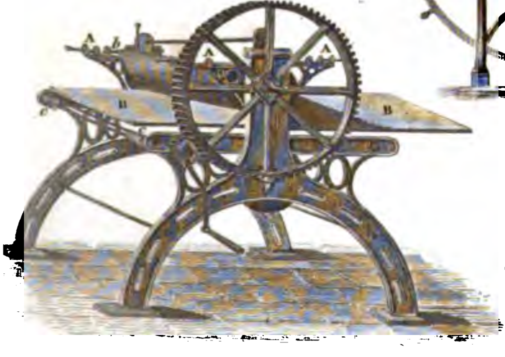

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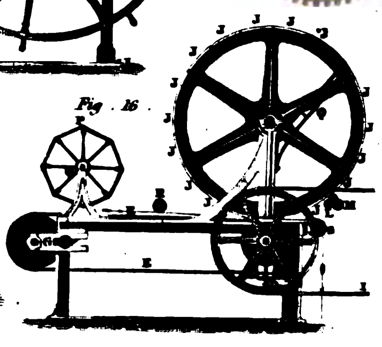

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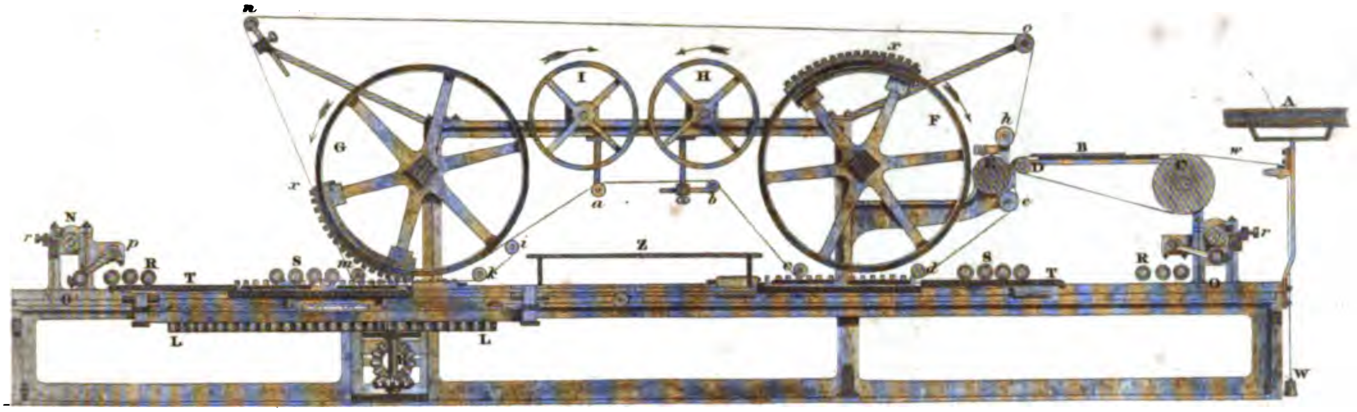
PRINTING MACHINERY. *PLATE CCCCLXIX.*

Fig. 1.



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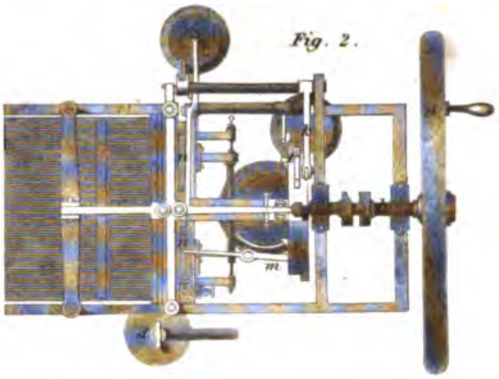

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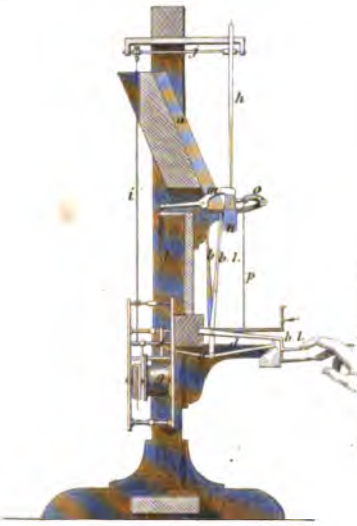

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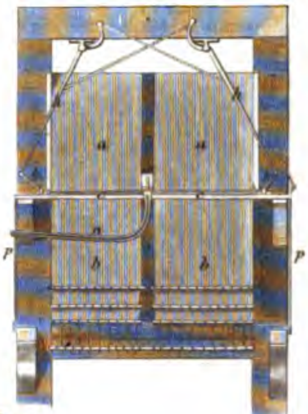

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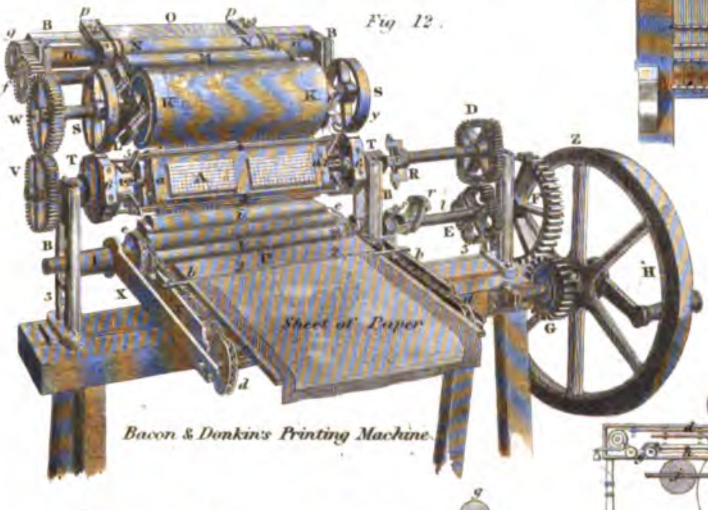
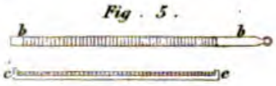


Bacon & Donkin's Printing Machine.

Fig. 5.



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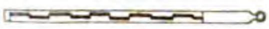

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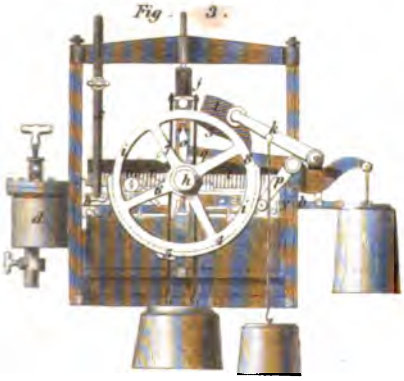

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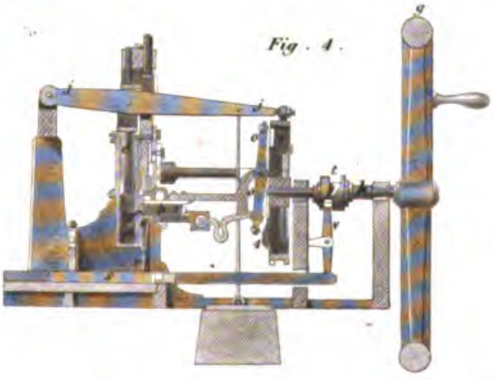

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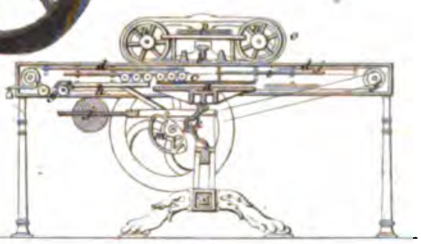

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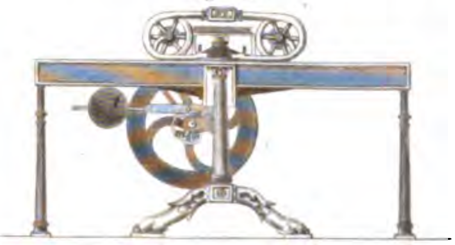

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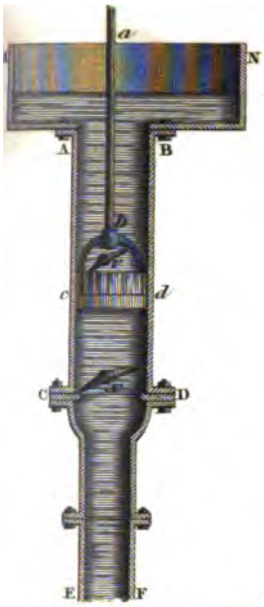
PUMP.

PLATE CCCCLXX.

Fig. 1.



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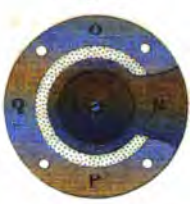

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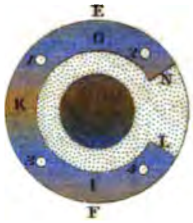

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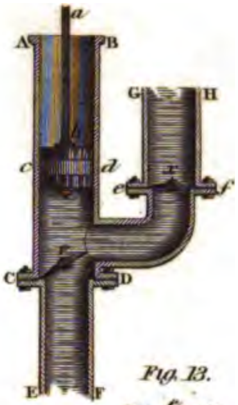

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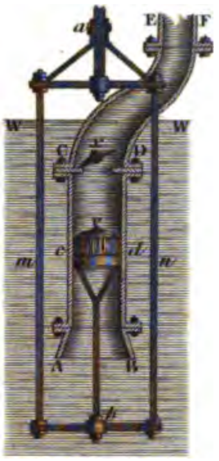

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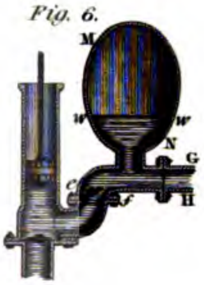

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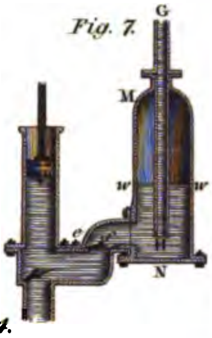

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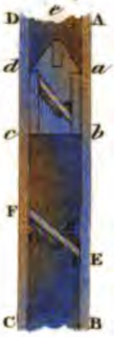

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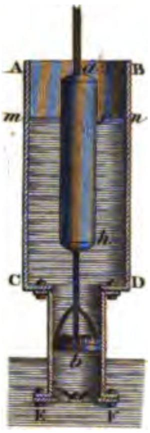

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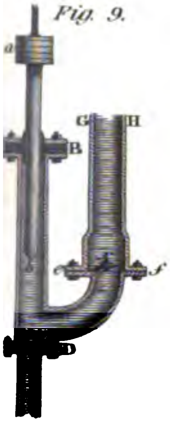

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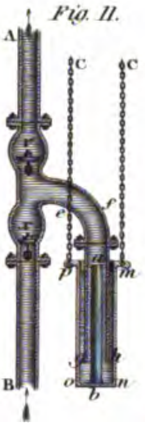

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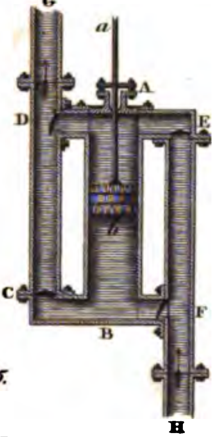

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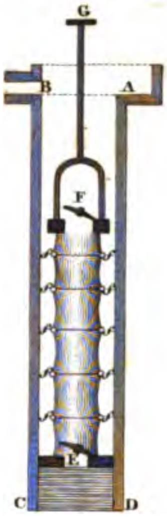

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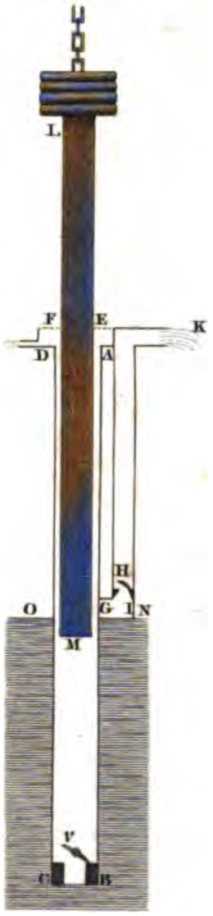

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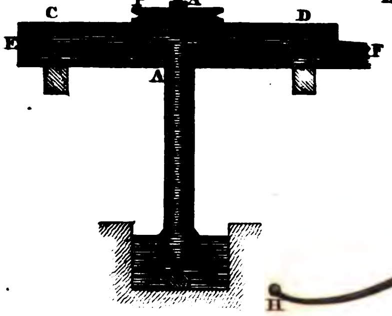

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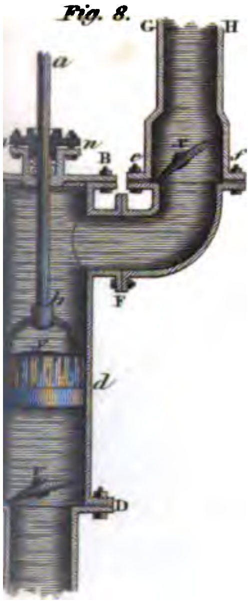

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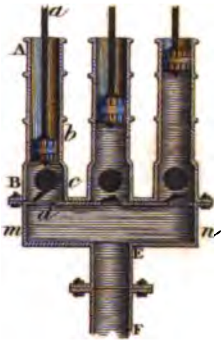

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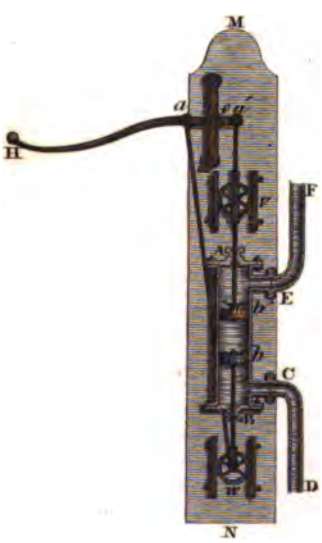

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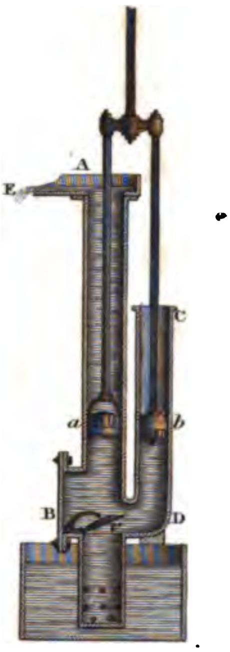

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PUMP.

PLATE CCCCLXXI No. I.

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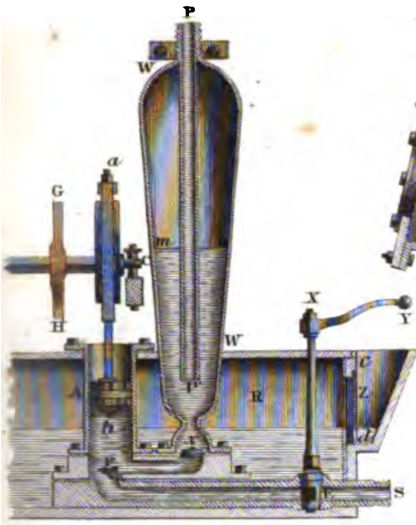

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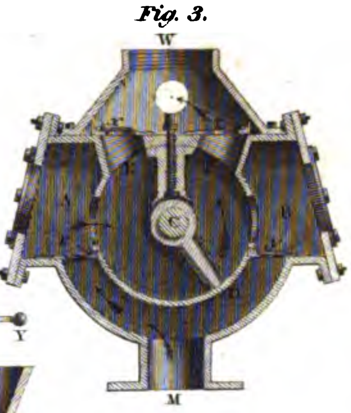

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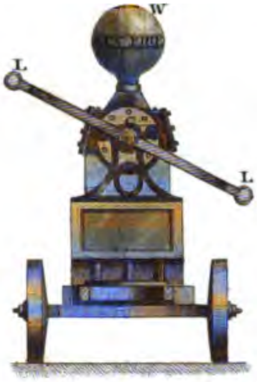

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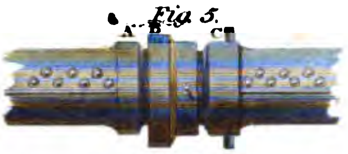

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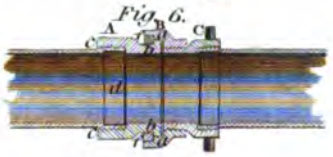

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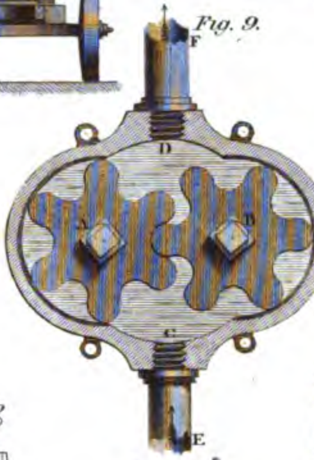

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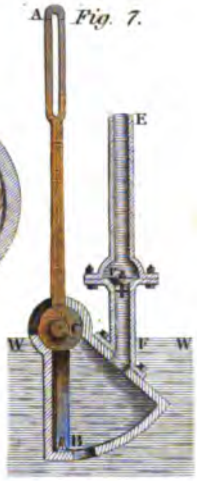

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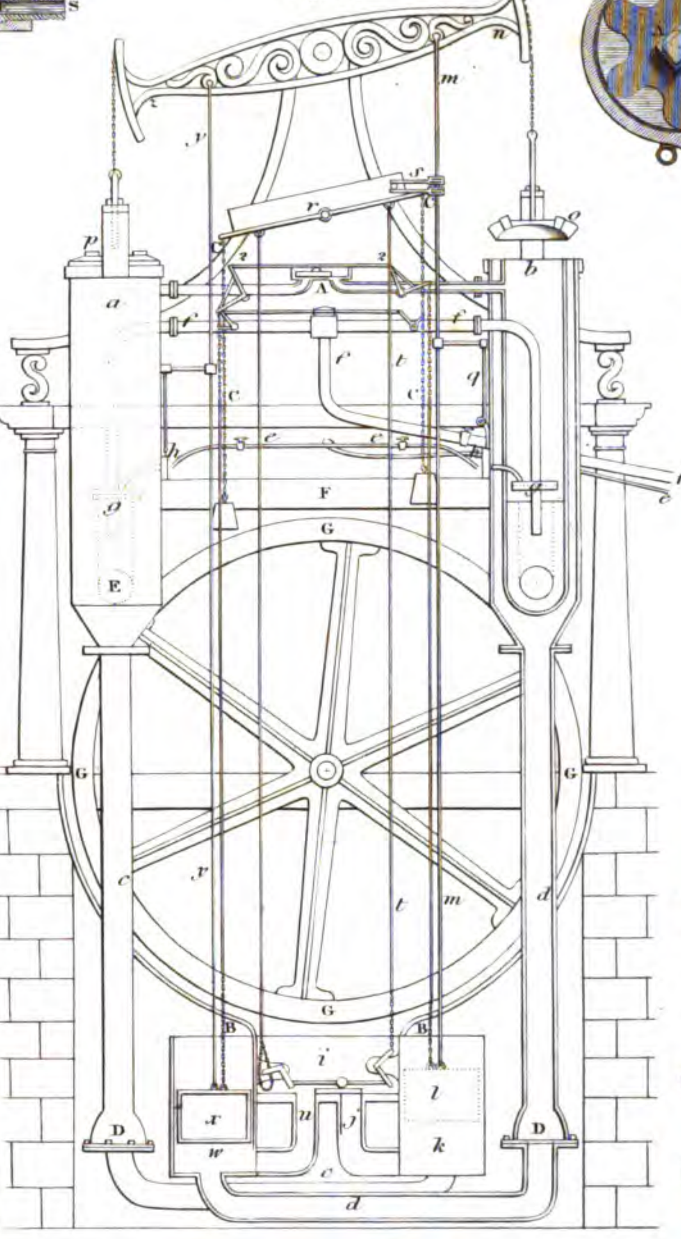

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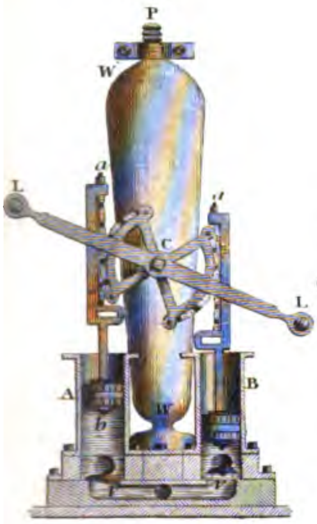

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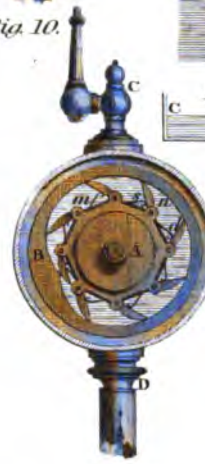

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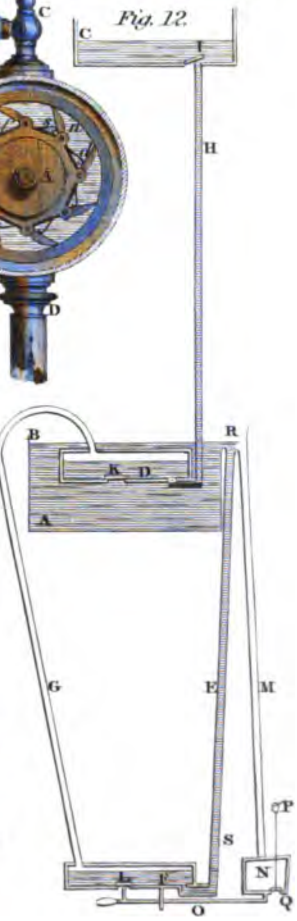

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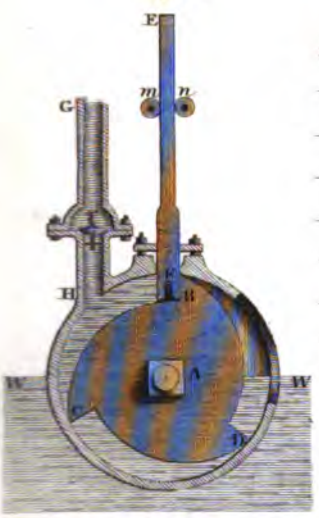

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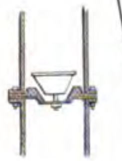

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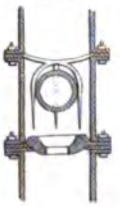

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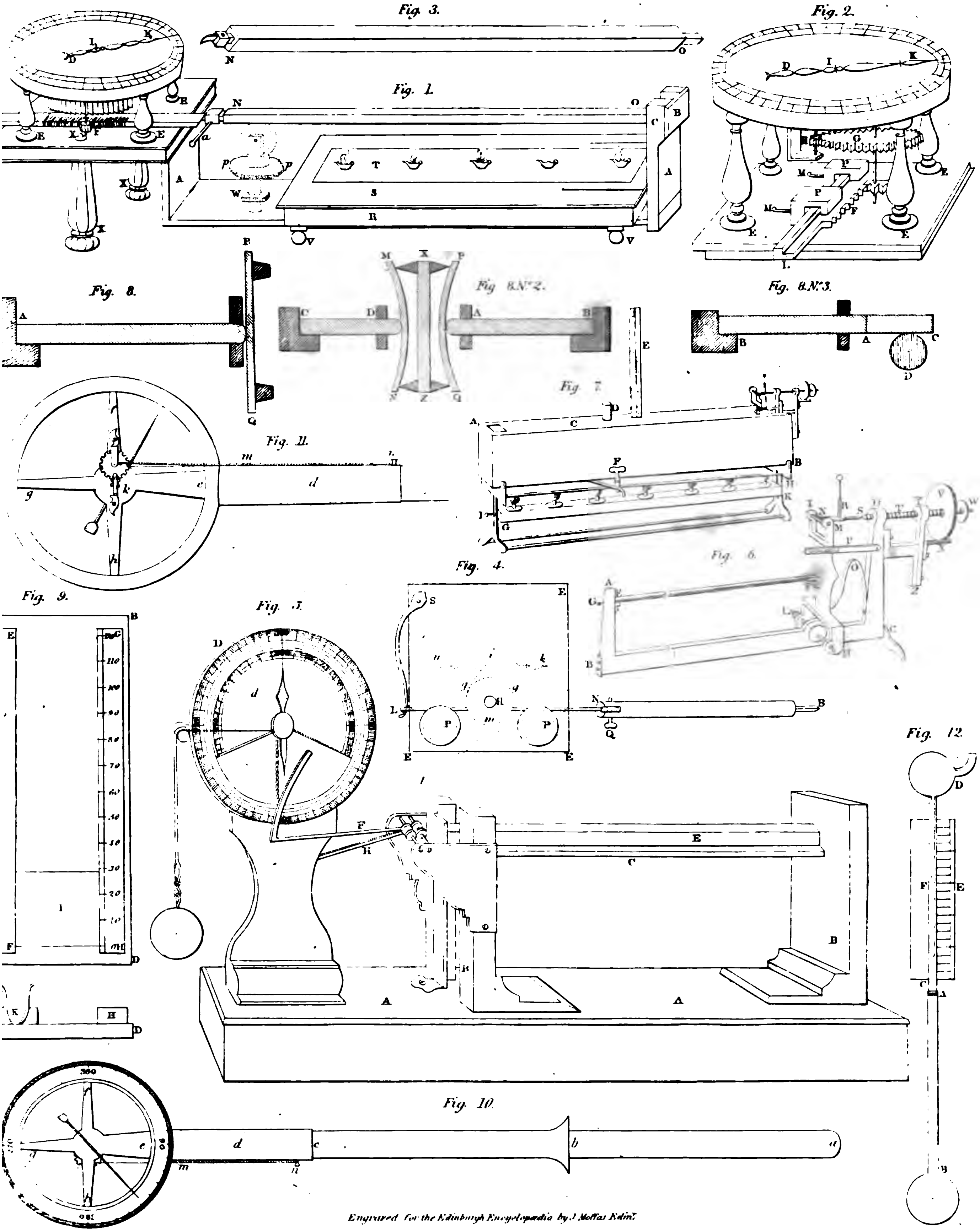
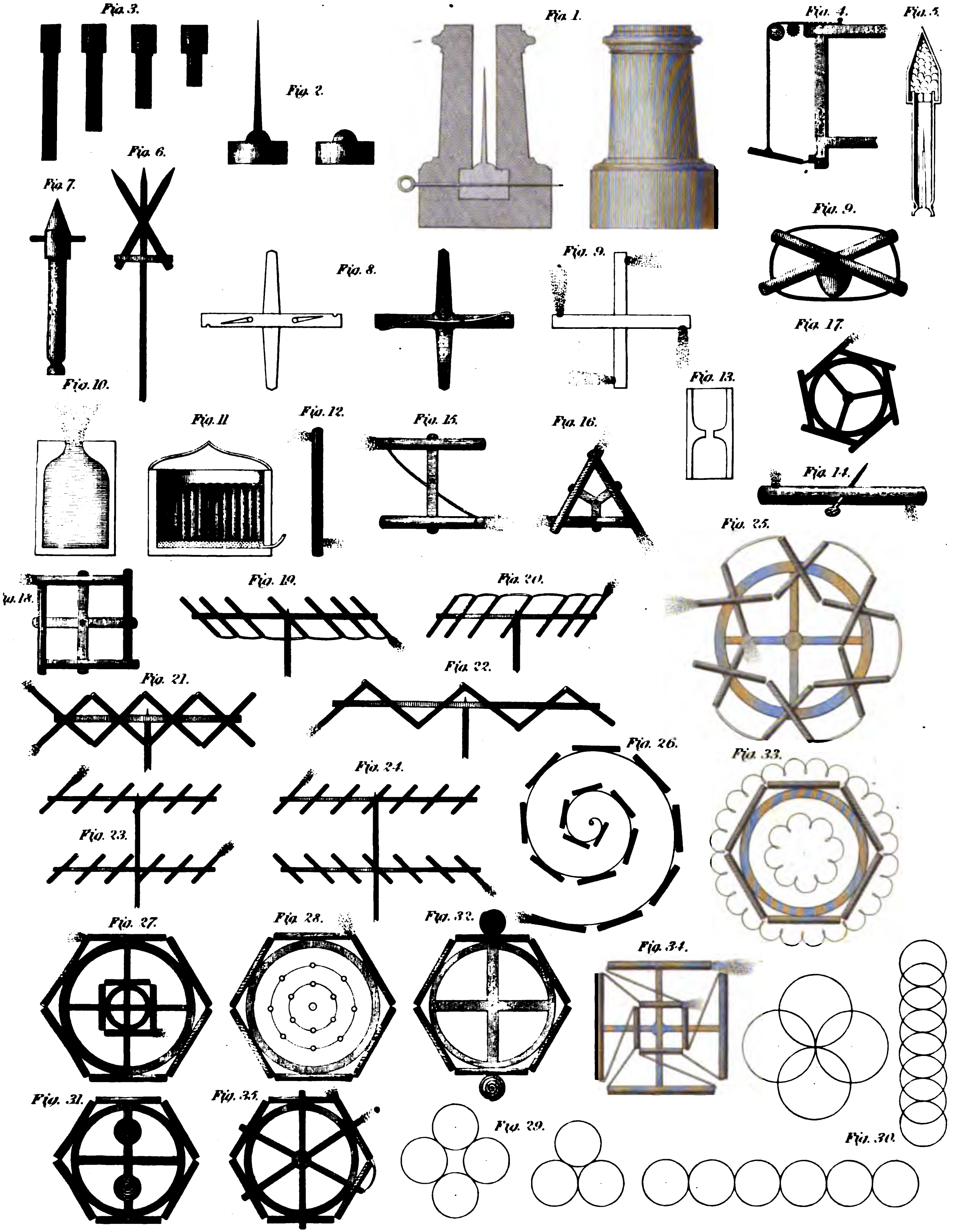
PYROMETER. PLATE CCCCLXXI No II.



Engraved for the Edinburgh Encyclopædia by J. Moffat Edin^r.

PYROTECHNY. PLATE CCCCLXXII.



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PYROTECHNY. *PLATE CCCCLXXIII.*

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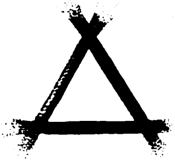

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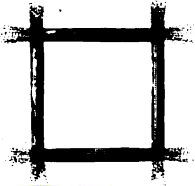

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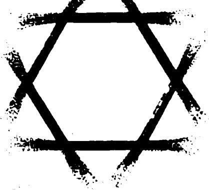

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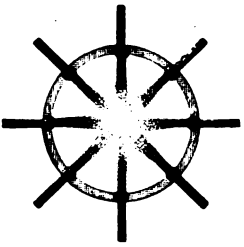

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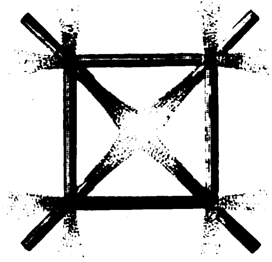

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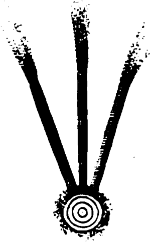

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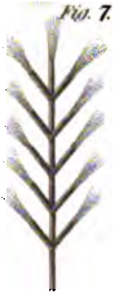

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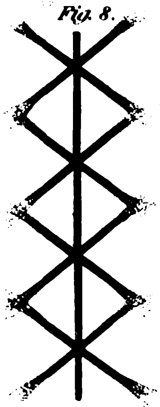

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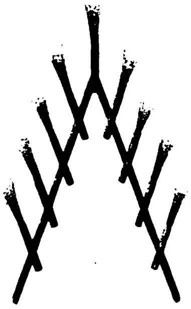

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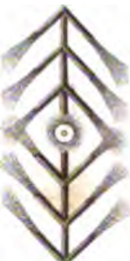

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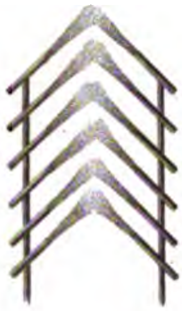

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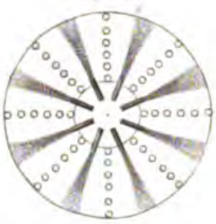

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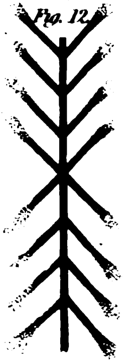

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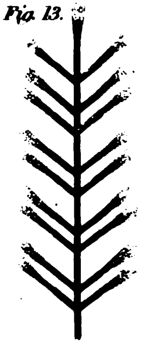

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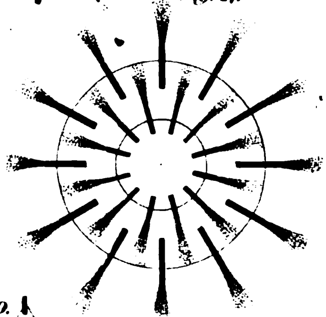

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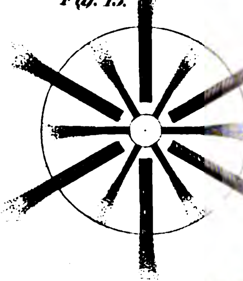

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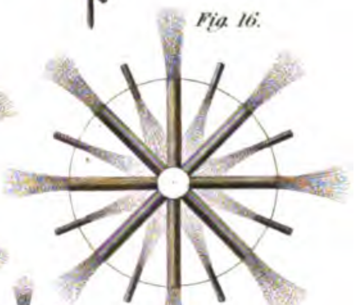

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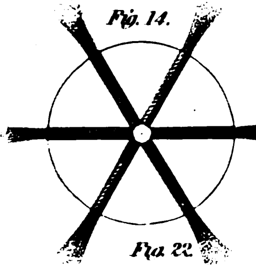

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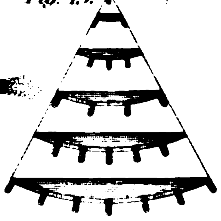

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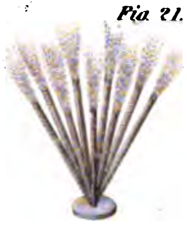

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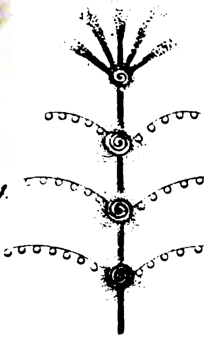

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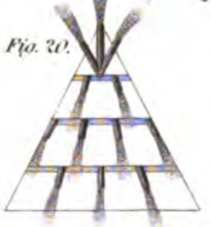

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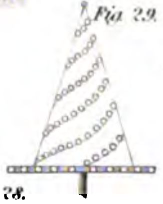

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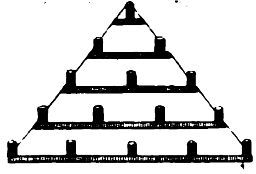

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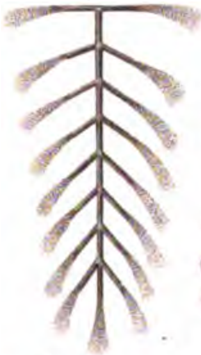

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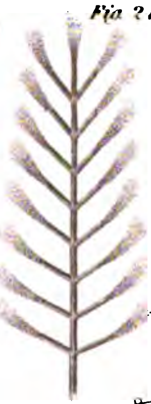

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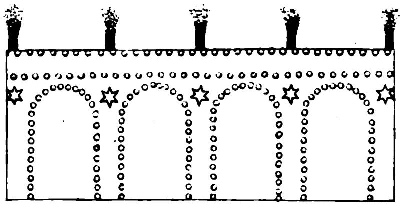

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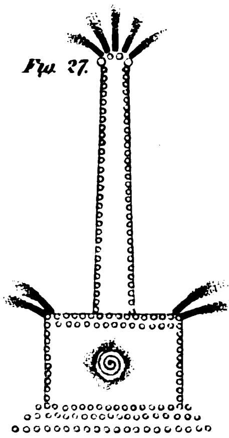

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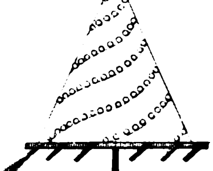

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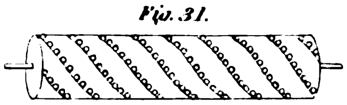

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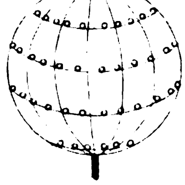

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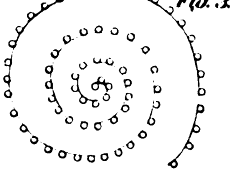

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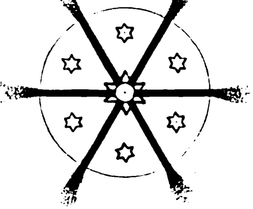

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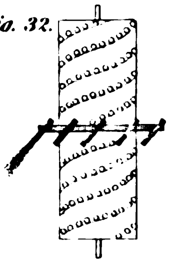

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PYROTECHNY. PLATE CCCCLXXIV.

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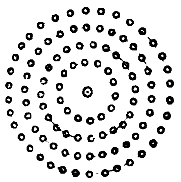

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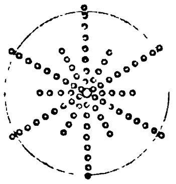

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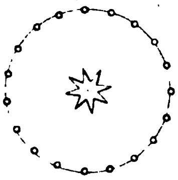

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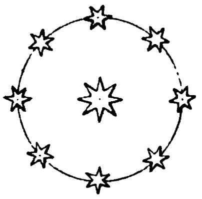

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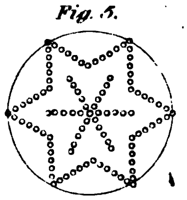

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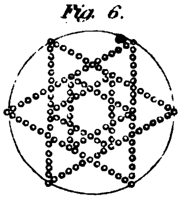

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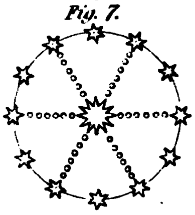

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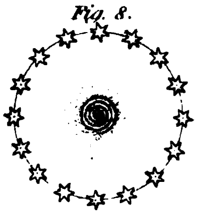

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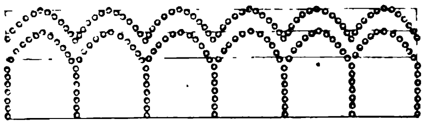

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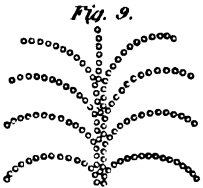

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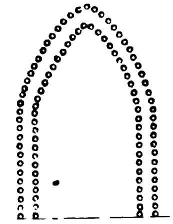

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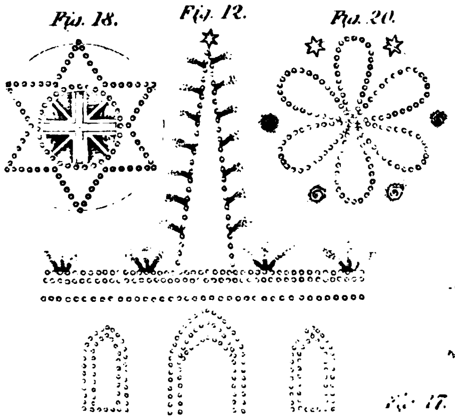

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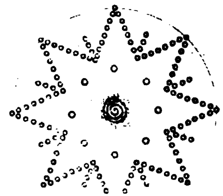

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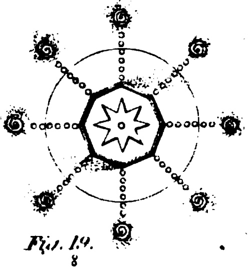

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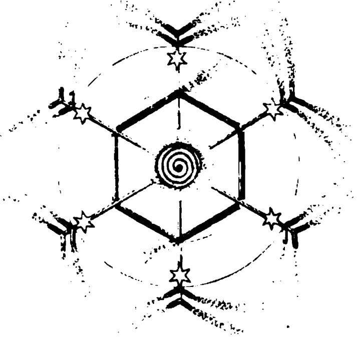

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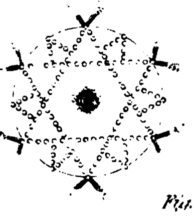

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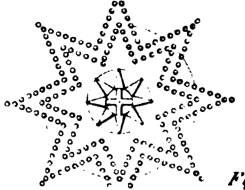

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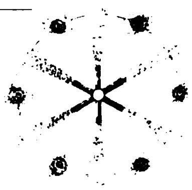

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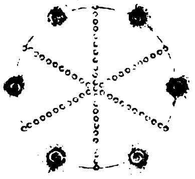

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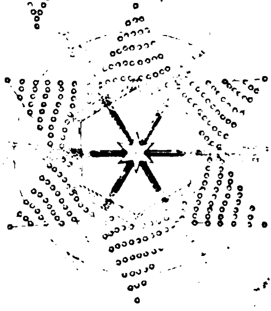

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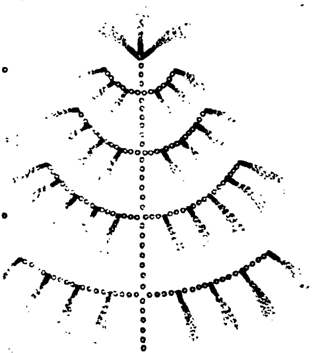

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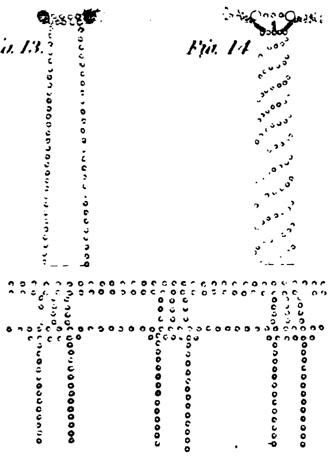

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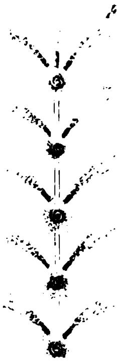

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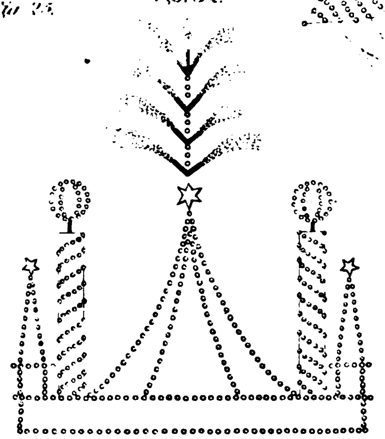

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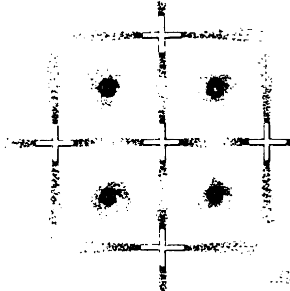

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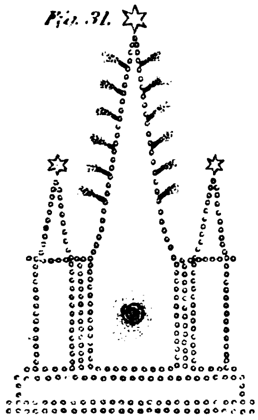

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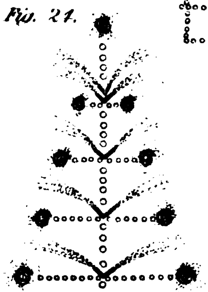

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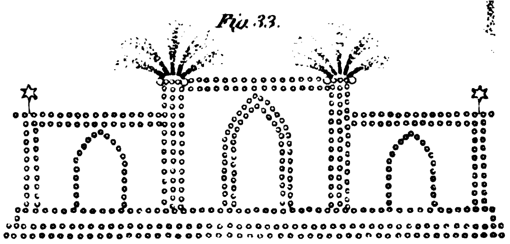

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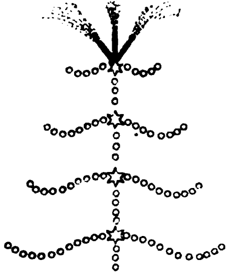

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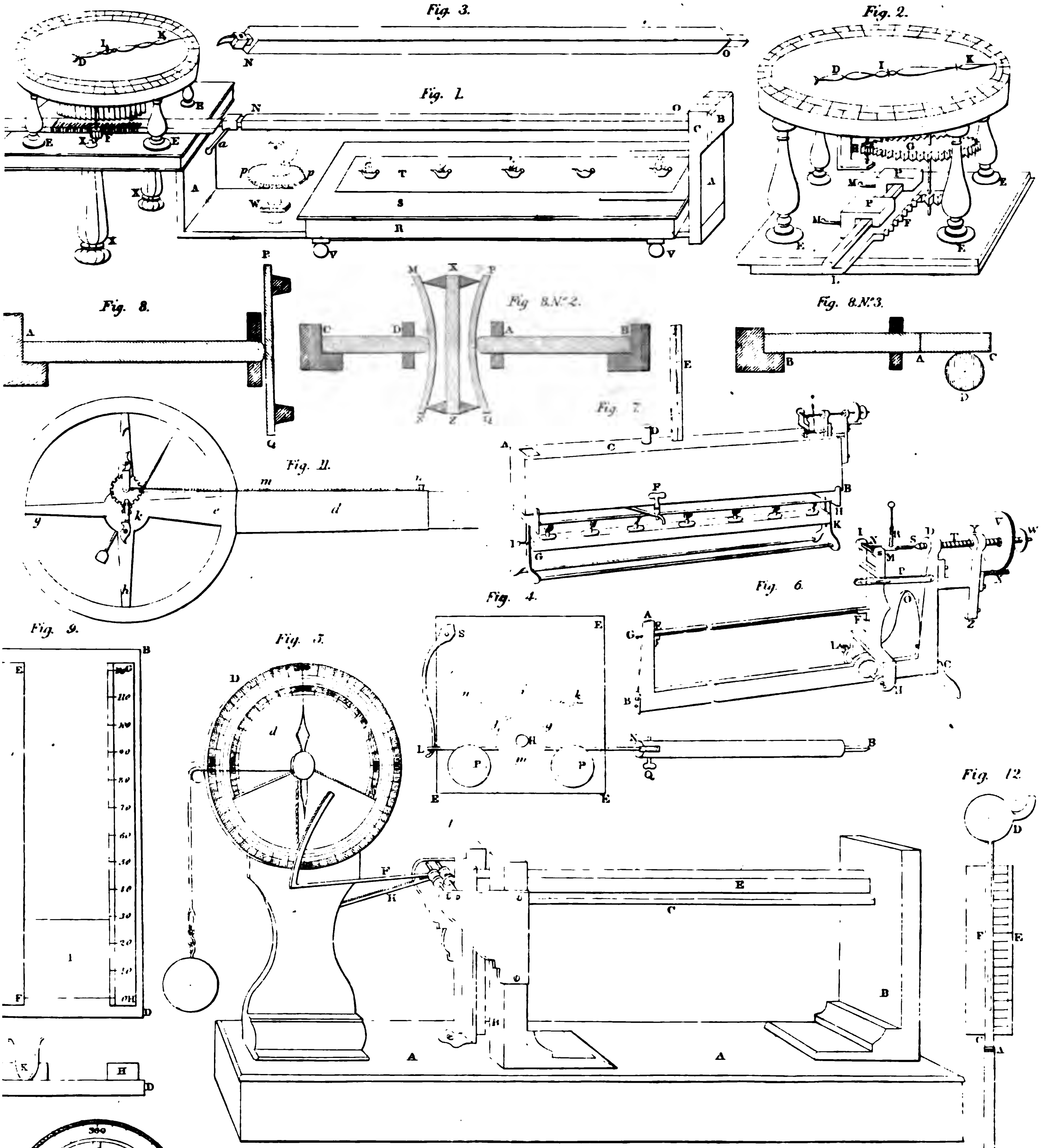
PYROMETER. PLATE CCCCLXVI No. II.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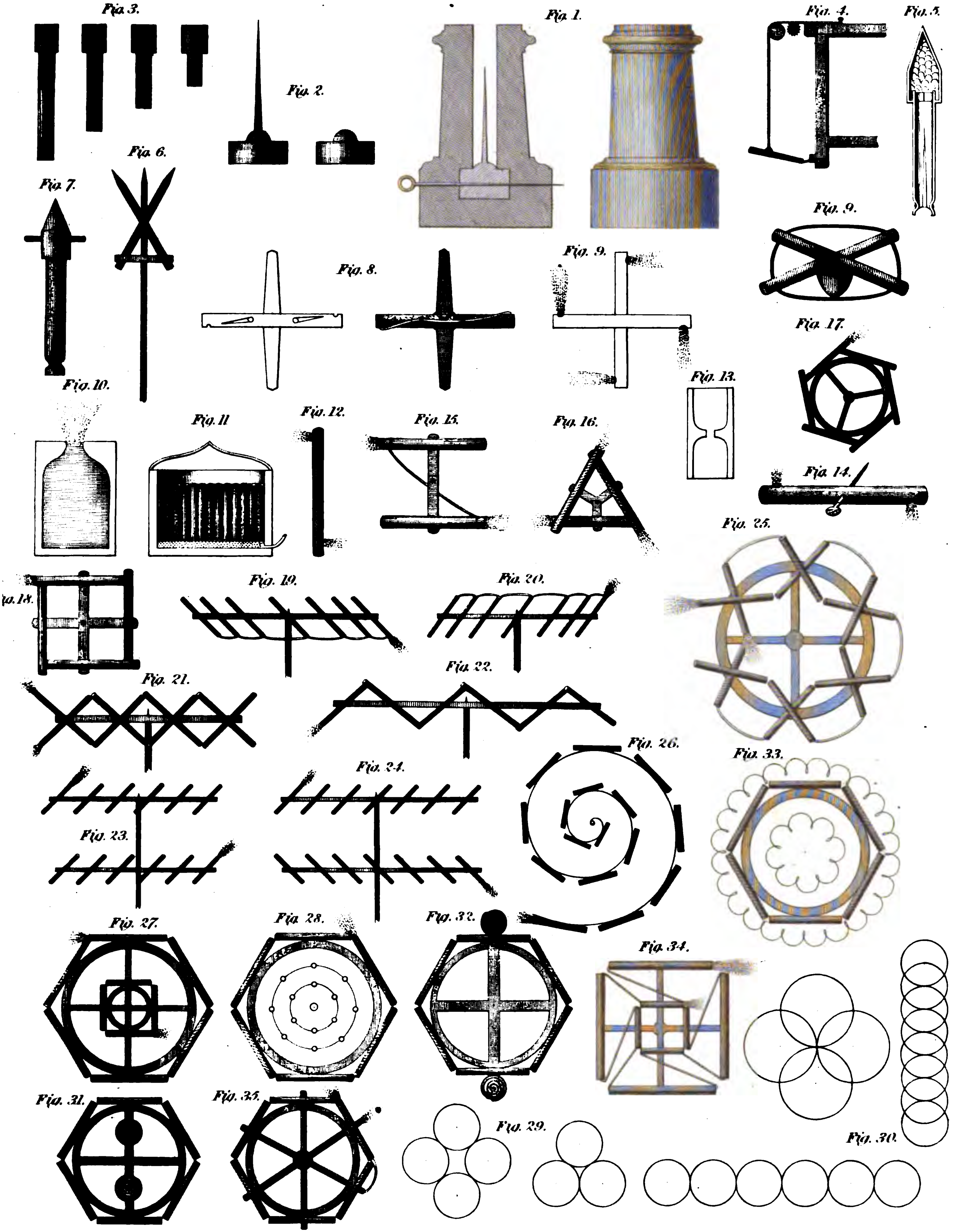
Engraved for the Edinburgh Encyclopaedia by J. Moffat Edinr.

PYROTECHNY. *PLATE CCCCLXXII.*



Drawn for the Edinburgh Encyclopaedia by J. McCulloch.

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PRINTING MACHINERY. *PLATE CCCCLXIX.*

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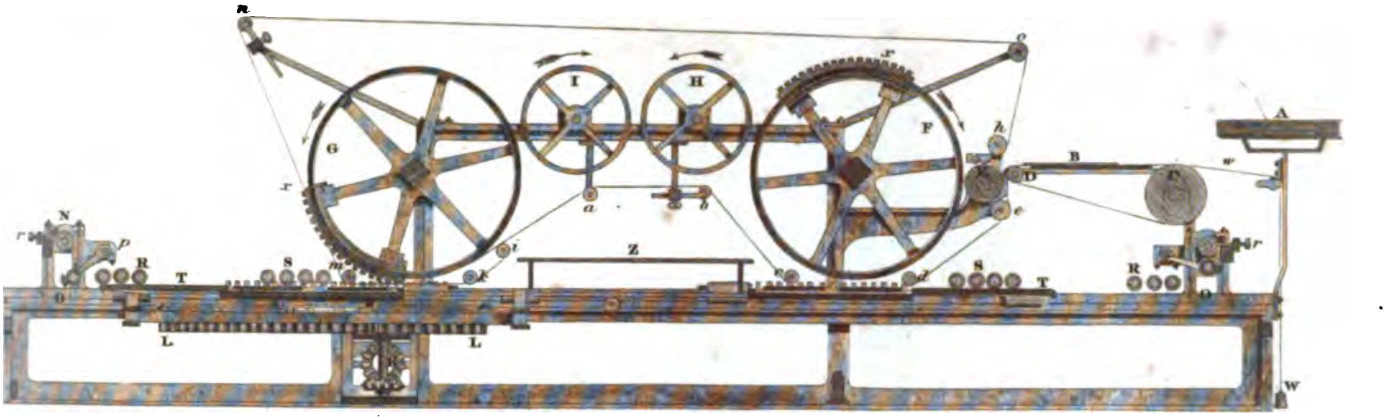

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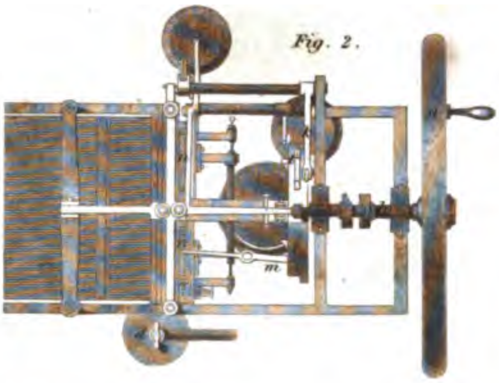

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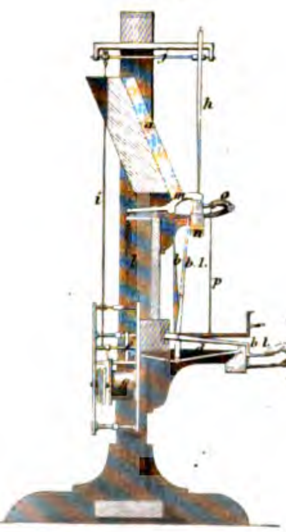

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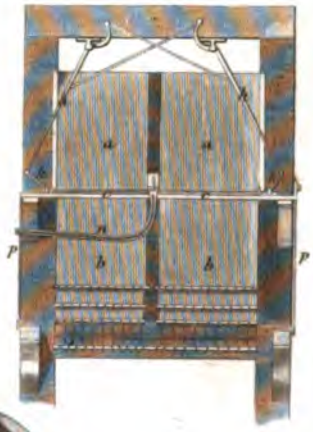

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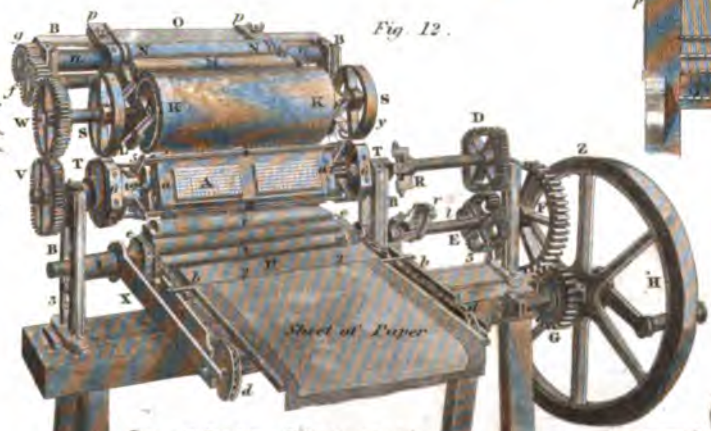

Bacon & Donkins Printing Machine.

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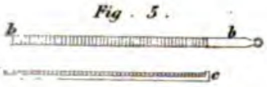

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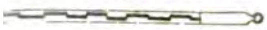

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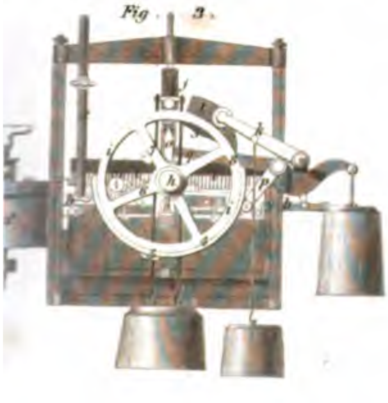

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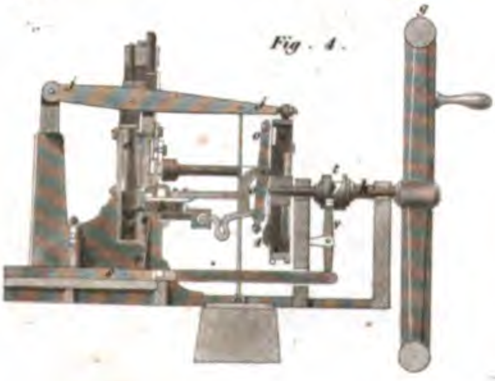

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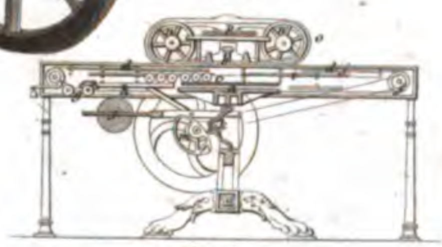

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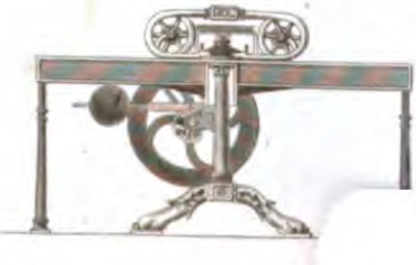

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PUMP. PLATE CCCCLXX.

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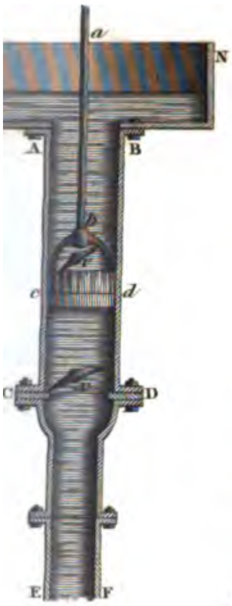

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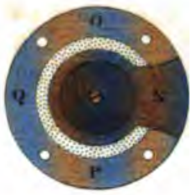

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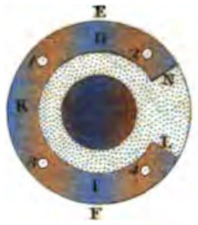

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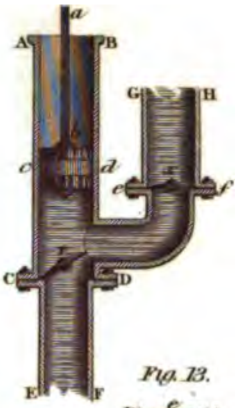

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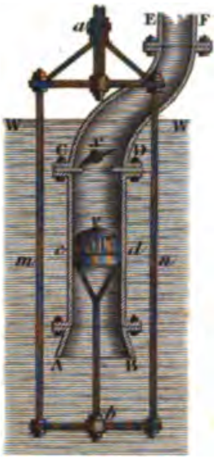

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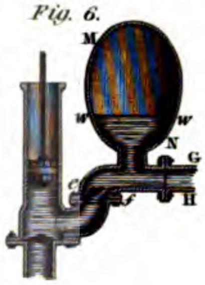

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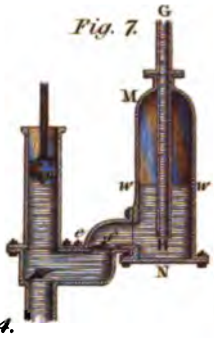

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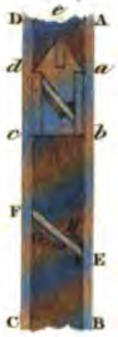

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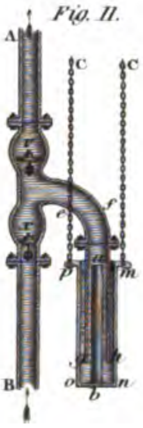

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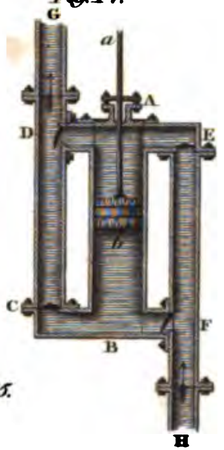

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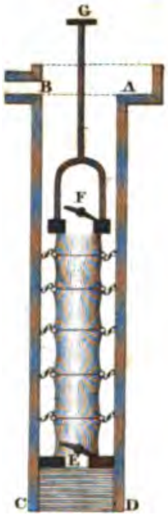

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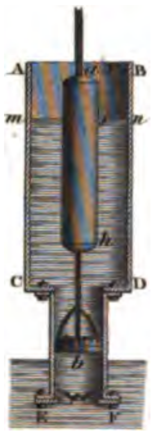

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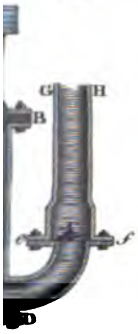

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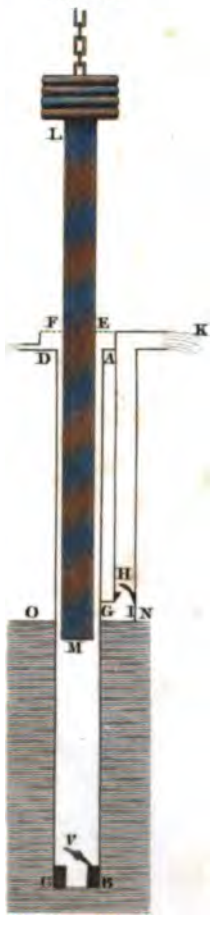

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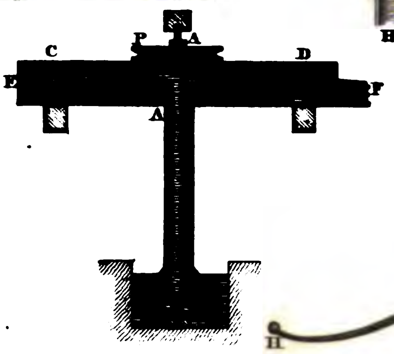

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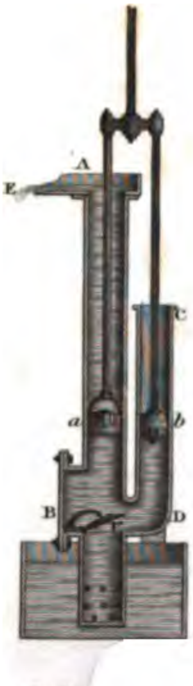

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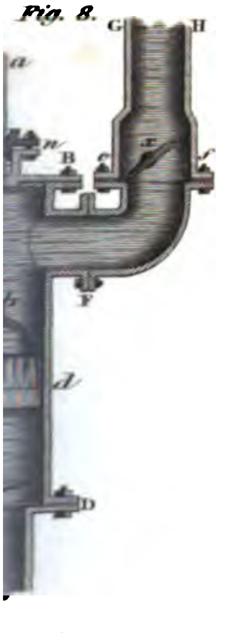

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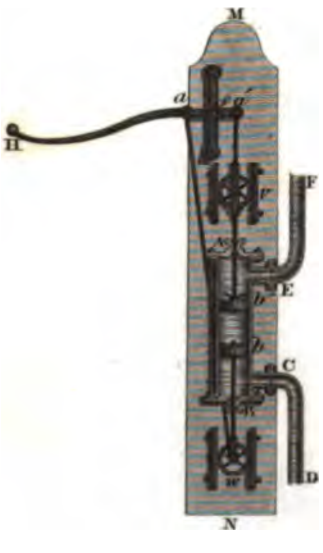

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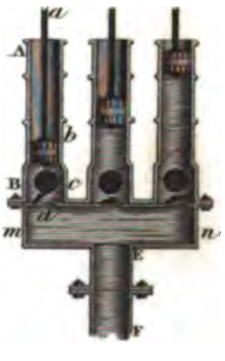

Edinburgh Encyclopaedia by J. Farey

Engd by

PYROTECHNY. PLATE CCCCLXXV.

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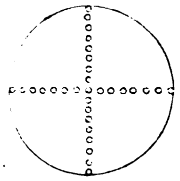

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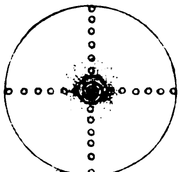

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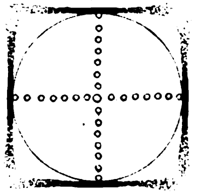

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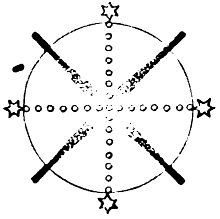

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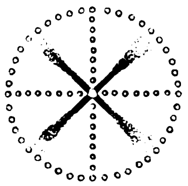

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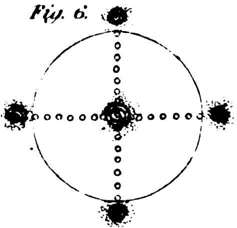

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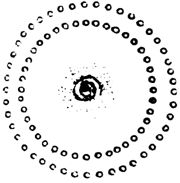

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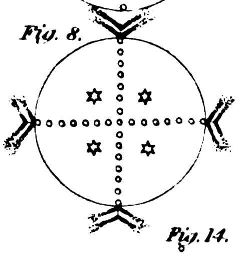

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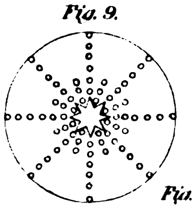

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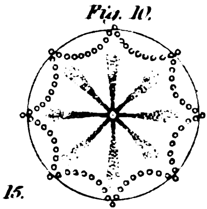

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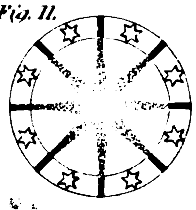

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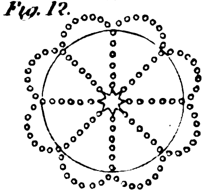

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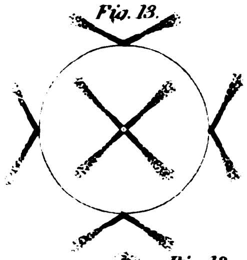

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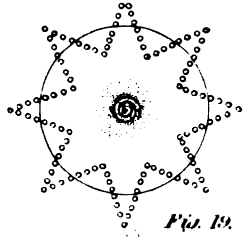

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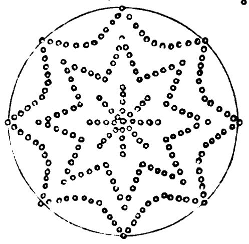

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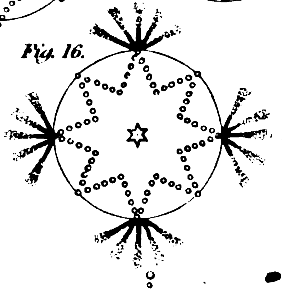

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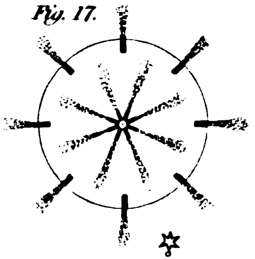

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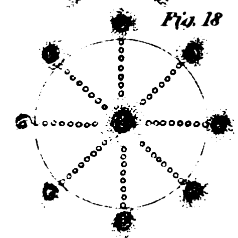
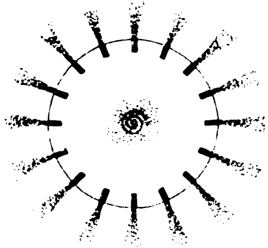


Fig. 19.



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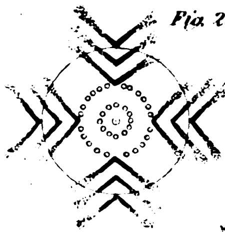

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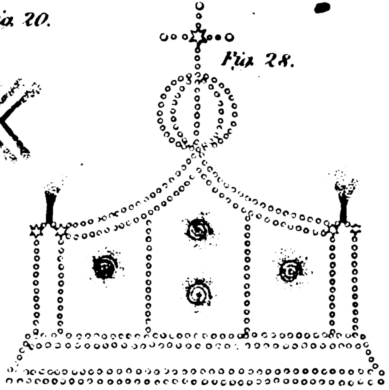

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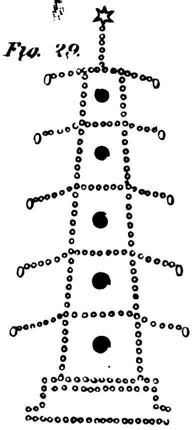

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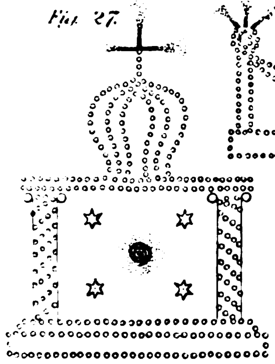

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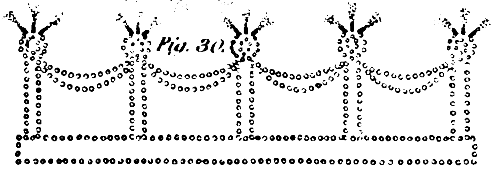

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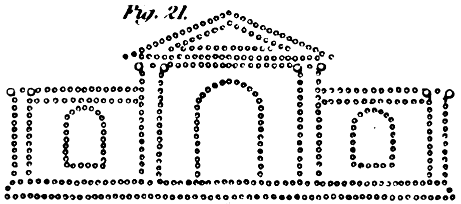

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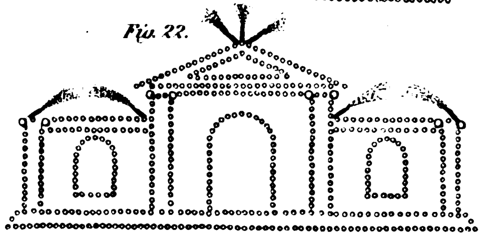

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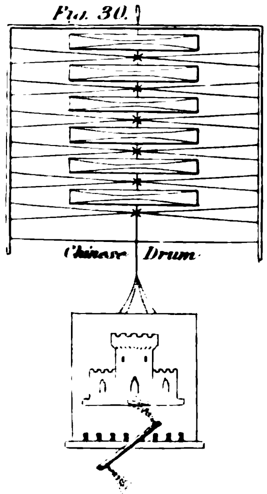
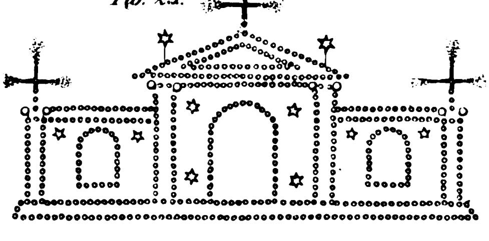


Chinese Drum

Fig. 23.



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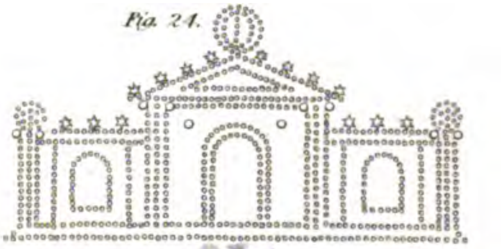

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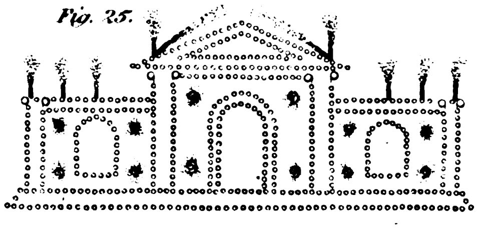

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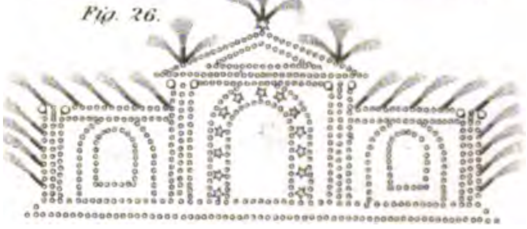

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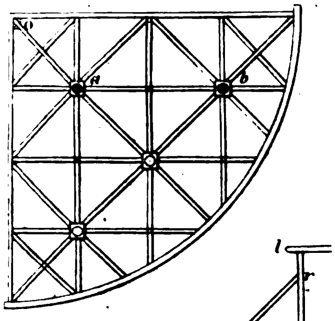
QUADRANT. PLATE CCCCLXXVI.

Fig. 1.



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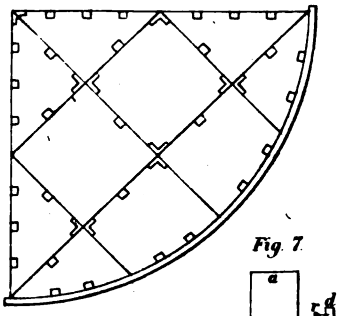

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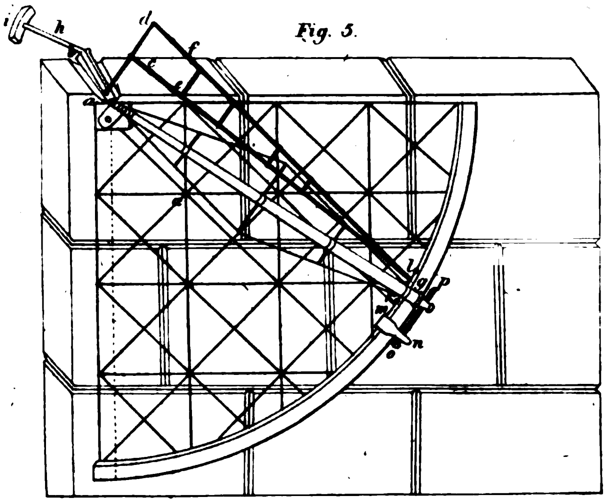

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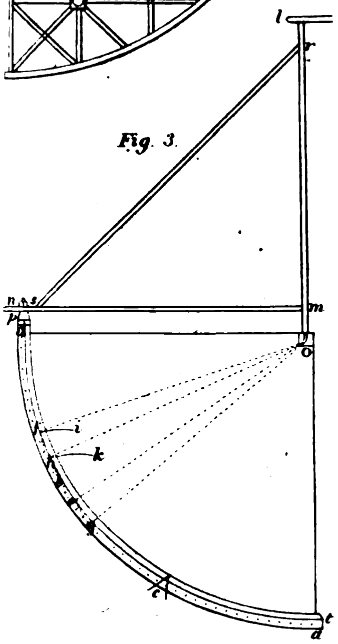

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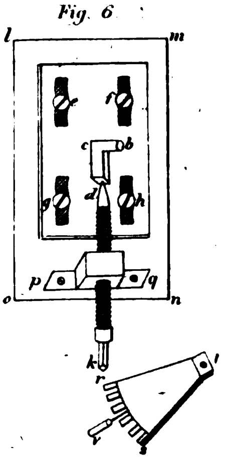


Fig. 7

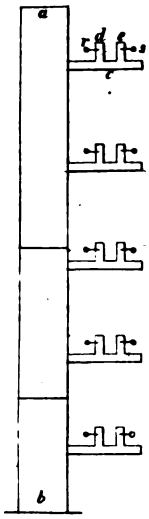


Fig. 11. Sutton's Quadrant.

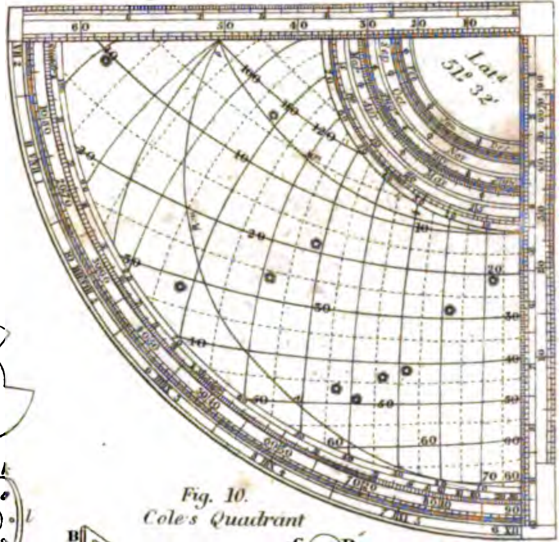
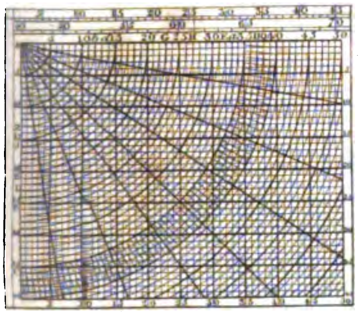


Fig. 13.
Sinical Quadrant



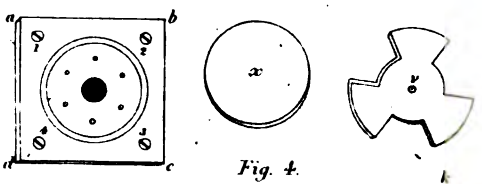
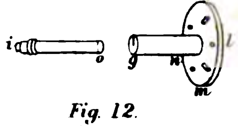


Fig. 4.



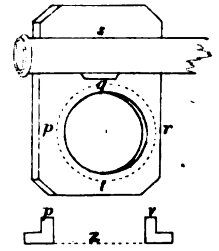


Fig. 10.
Cole's Quadrant

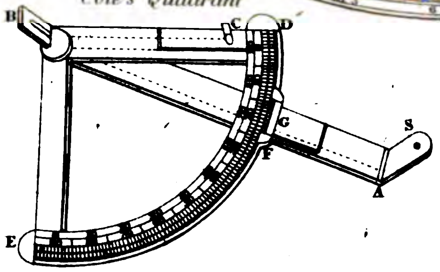


Fig. 12.
Horodictical Quadrant

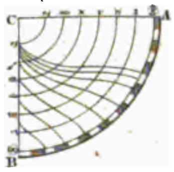


Fig. 8.

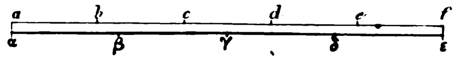


Fig. 9.

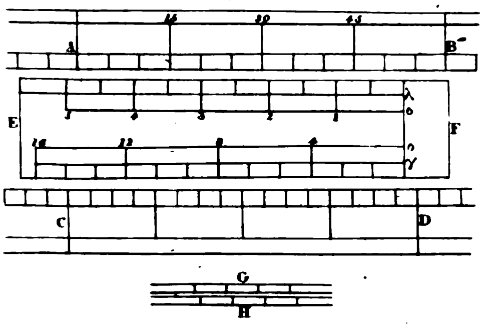


Fig. 14
Gunner's Quadrant

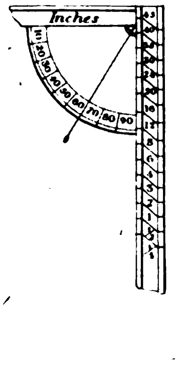


Fig. 15.
Front View

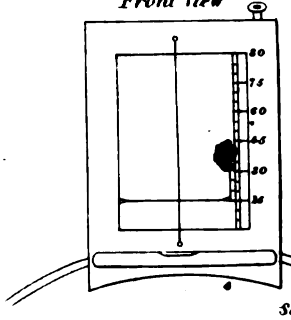
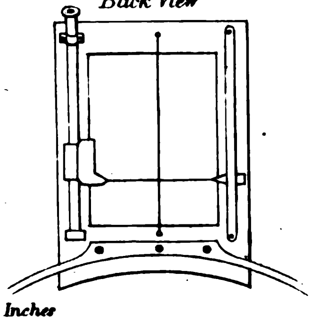
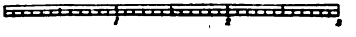


Fig. 16.
Back View



Scale of Inches



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RAILWAY LOCK. PLATE CCCCLXXVII.

Fig. 7. Perpendicular Section of Lock

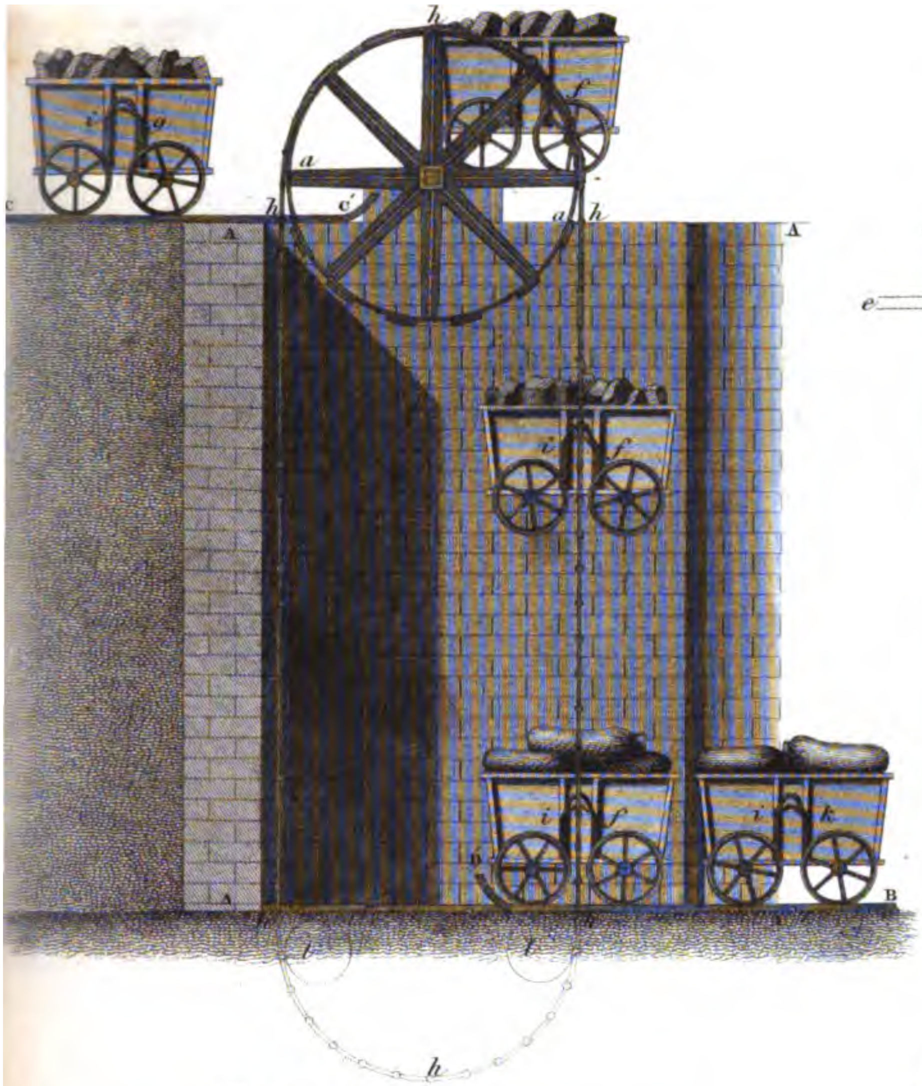


Fig. 6. Elevation of Lock

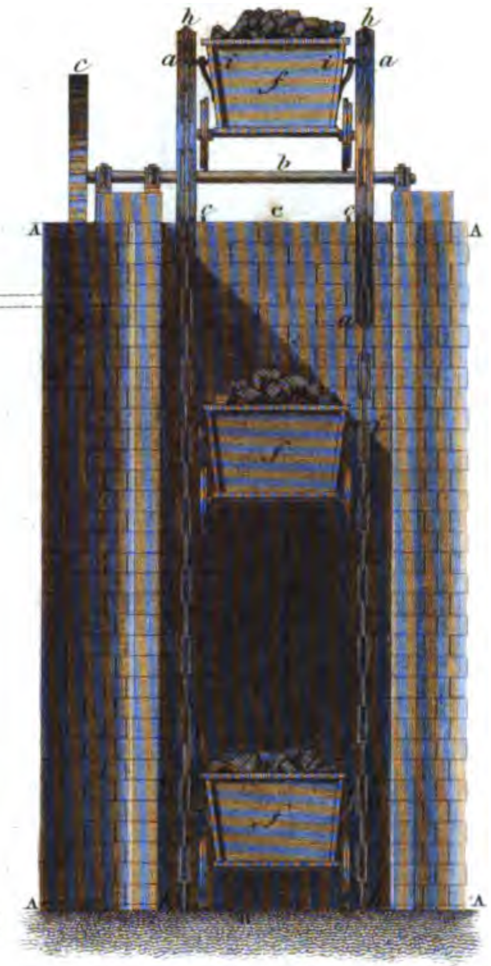


Fig. 5. Plan of Lock

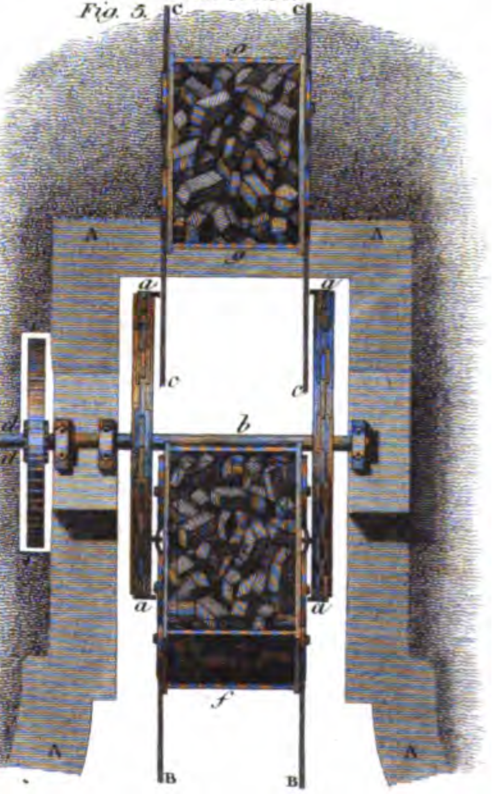


Fig. 4. Edge Railway

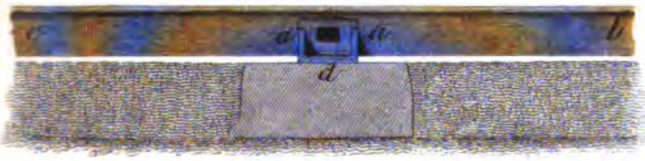
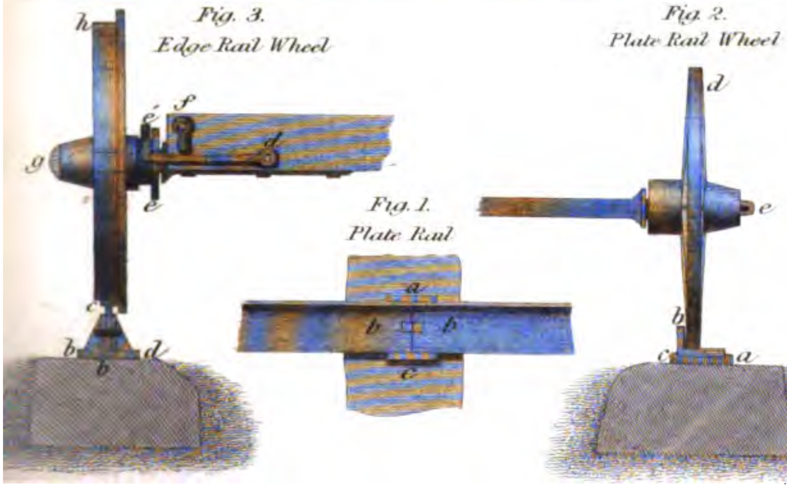


Fig. 3. Edge Rail Wheel

Fig. 2. Plate Rail Wheel

Fig. 1. Plate Rail



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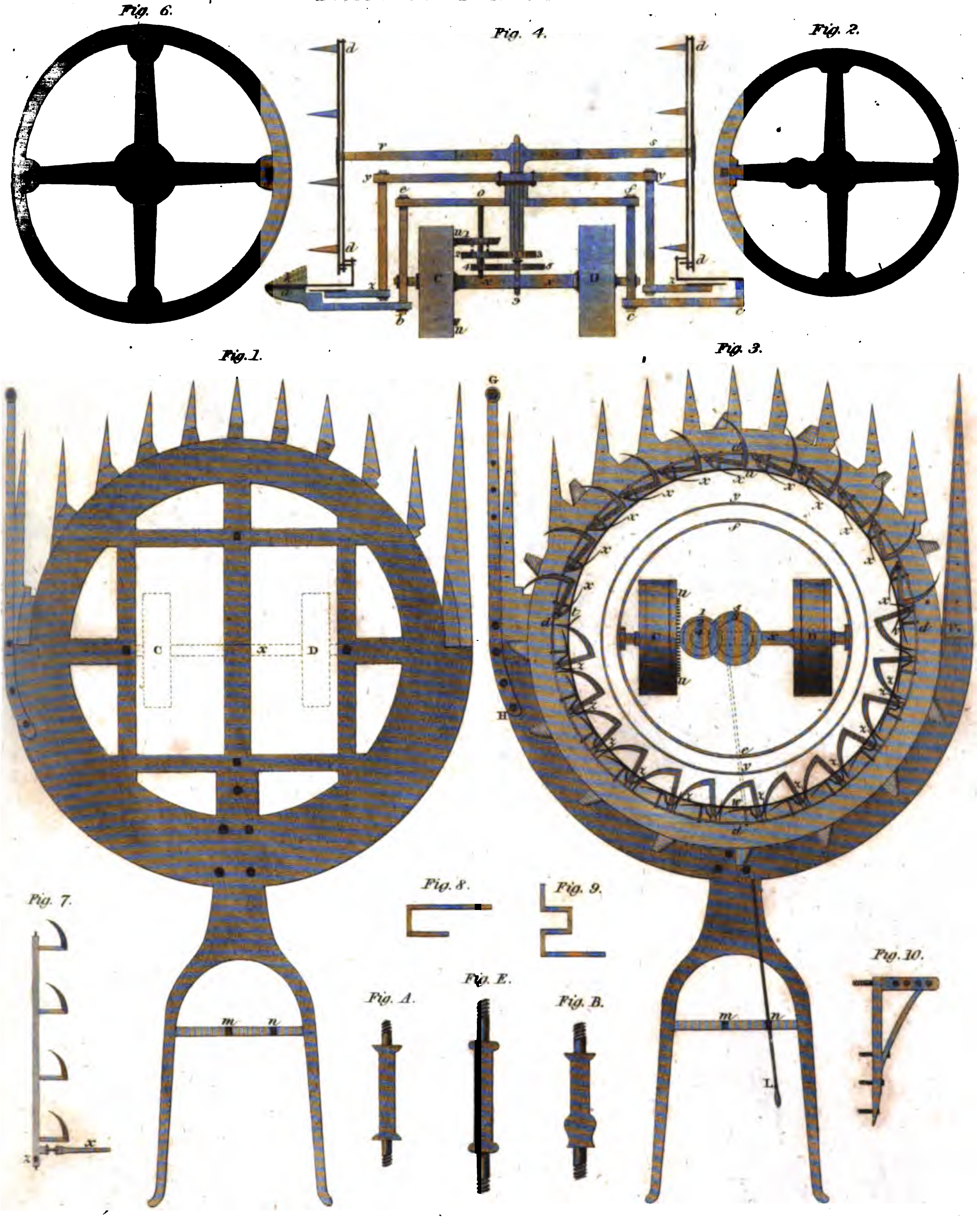
REAPING MACHINE. *PLATE CCCCLXXVIII.*



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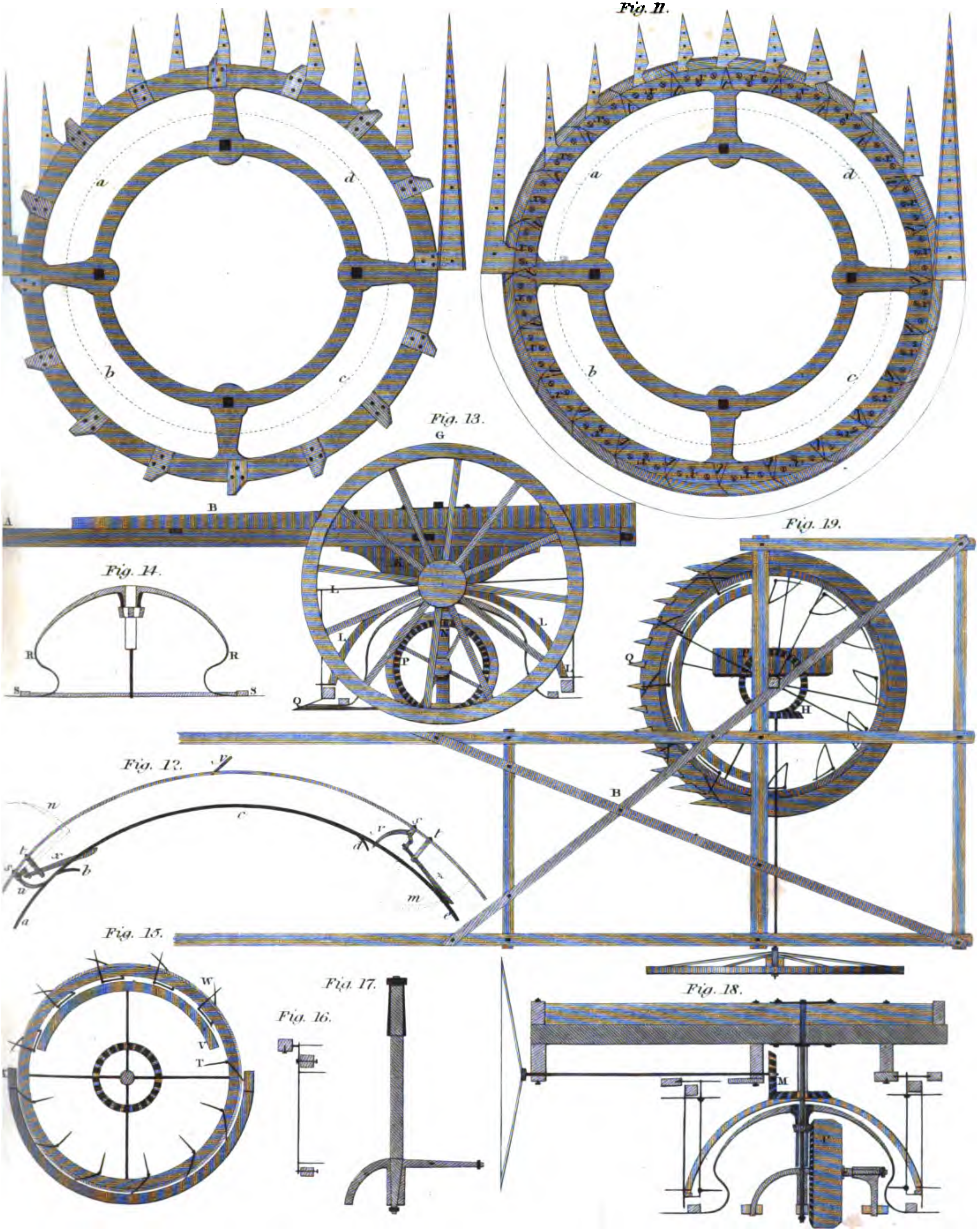
REAPING MACHINE. *PLATE CCCCLXXIX.*



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ROAD. PLATE CCCCLXXX.

MR STEVENSON'S DESIGN for a SMOOTH and DURABLE CITY ROAD.

Fig. 2. Section.

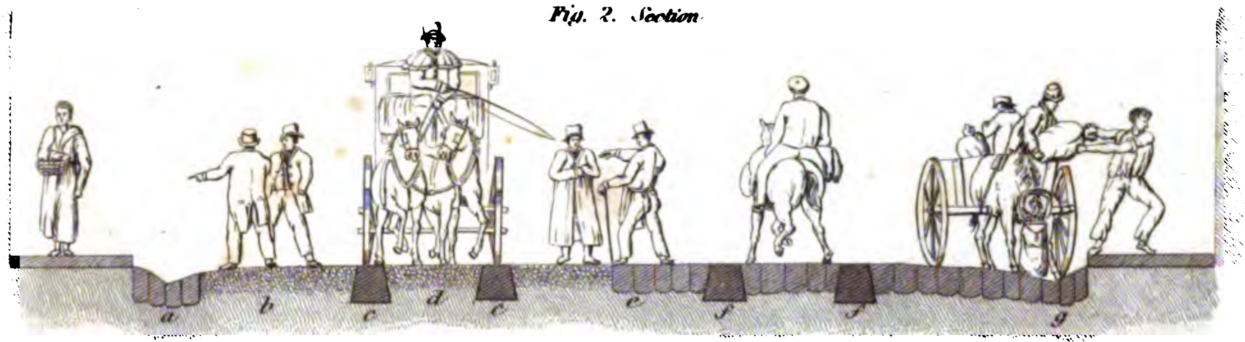
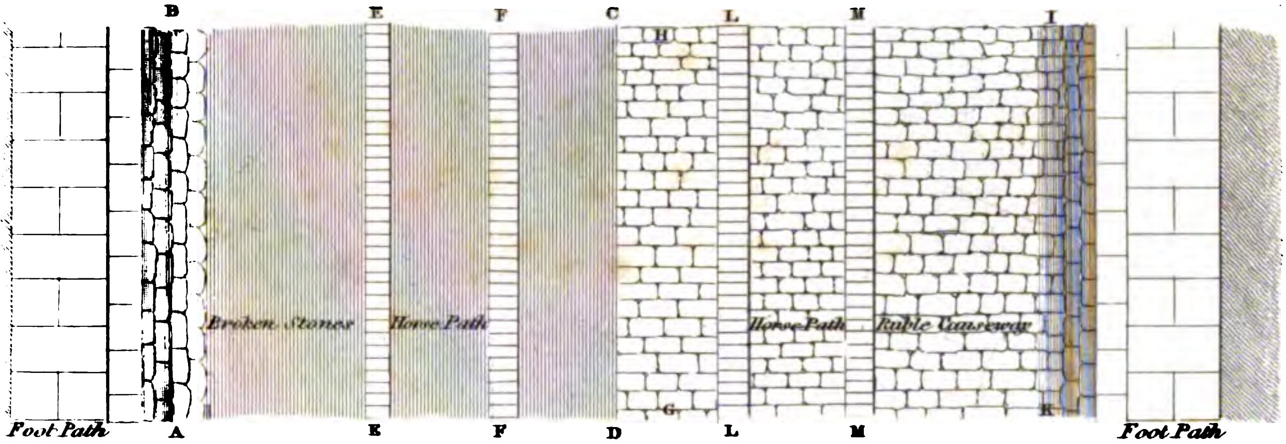
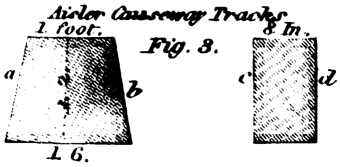


Fig. 1. Plan of the Road.



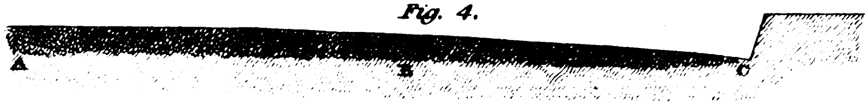
Aisler Causeway Tracks.

Fig. 3.

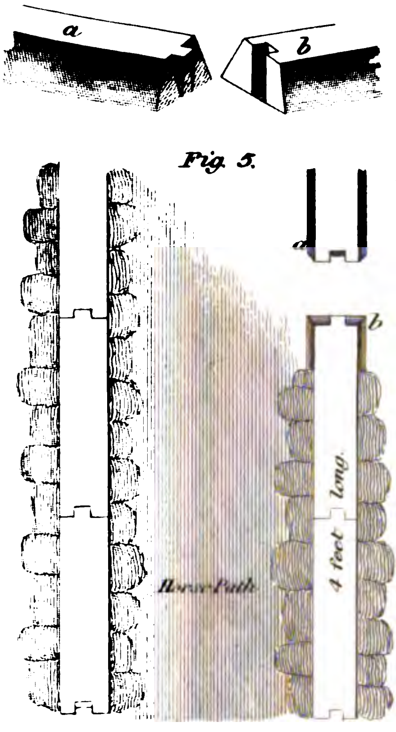


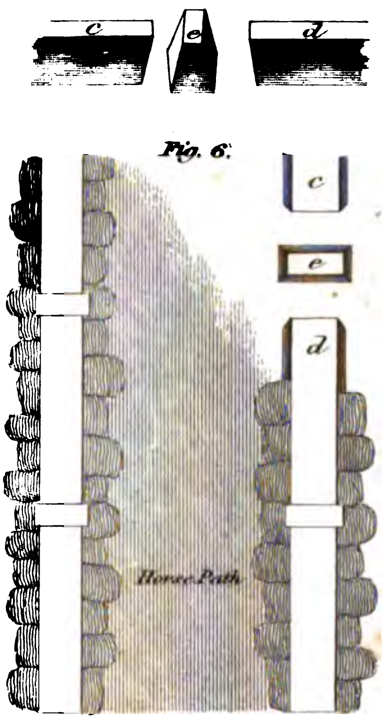
Cross Section of a Common Road

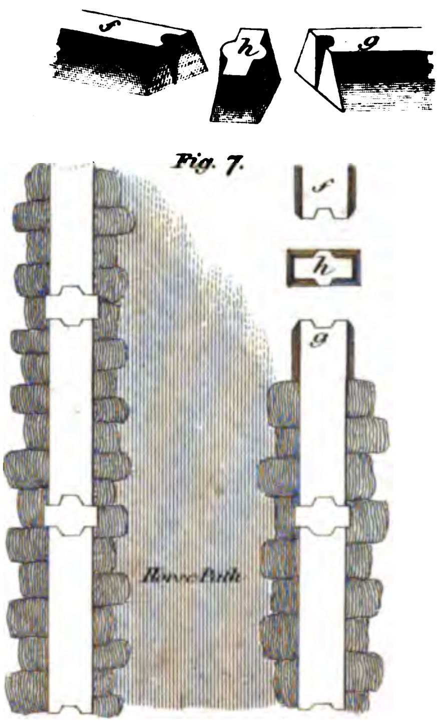
Fig. 4.



MR H. MATHEWS' DESIGNS for a STONE RAILWAY.







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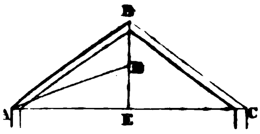
ROOFS.

PLATE CCCCLXXXI.

Fig. 1.



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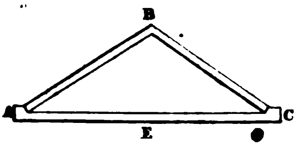


Fig. 3.

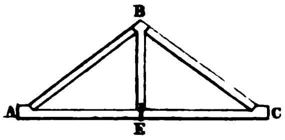
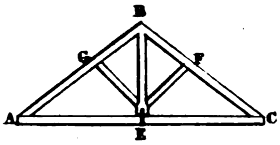


Fig. 4.



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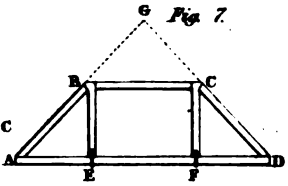
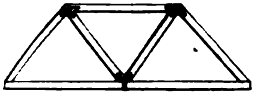


Fig. 8.



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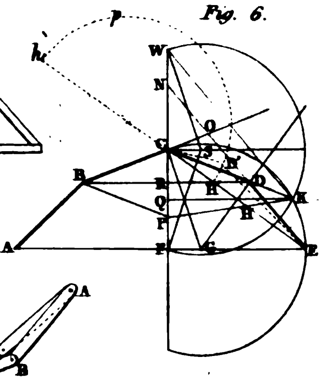

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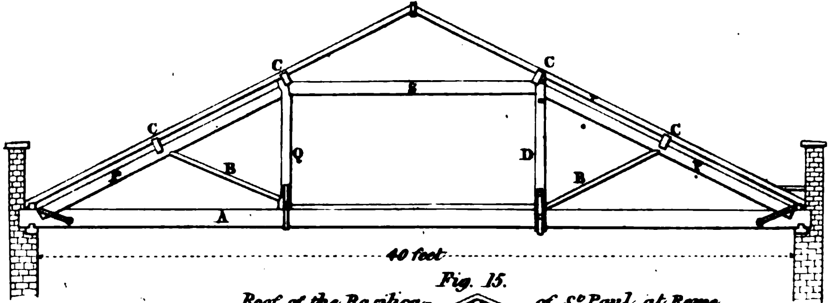


Fig. 5.

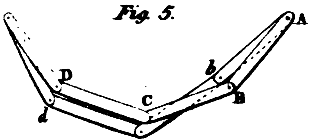


Fig. 15.

Roof of the Basilica of S.t Paul at Rome.

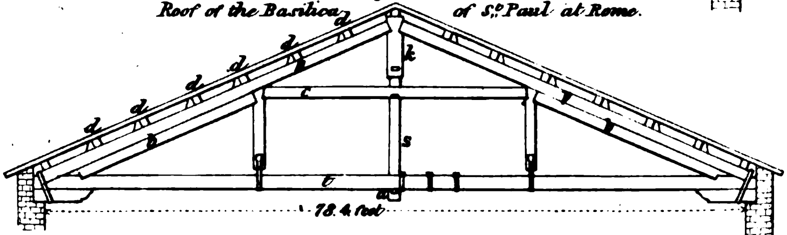
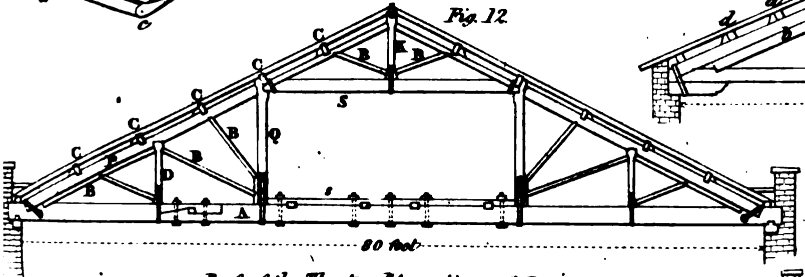


Fig. 12.



Roof of the Theatre d'Argentina at Rome

Fig. 13.

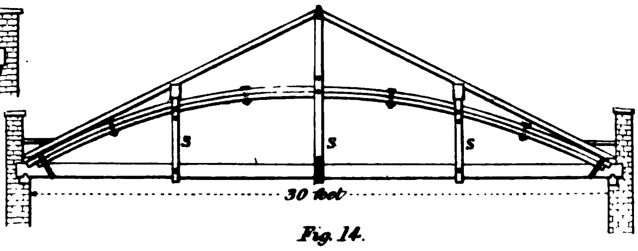
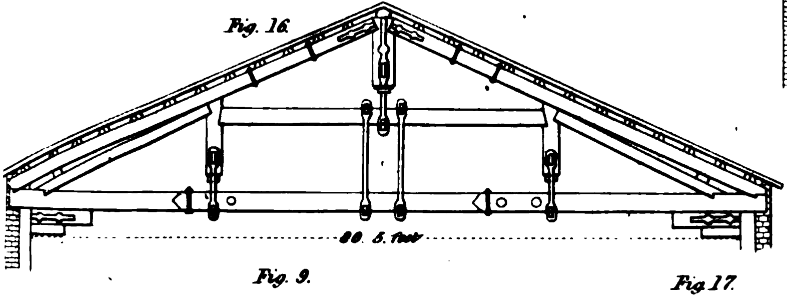


Fig. 16.



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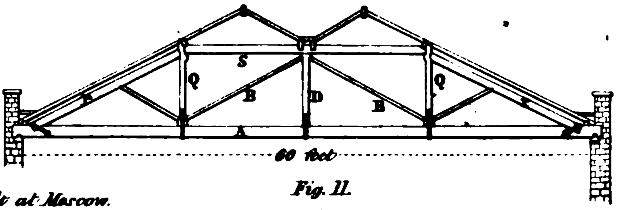

Fig. 9.

Fig. 17.

Roof of a Riding House that was built at Moscow.

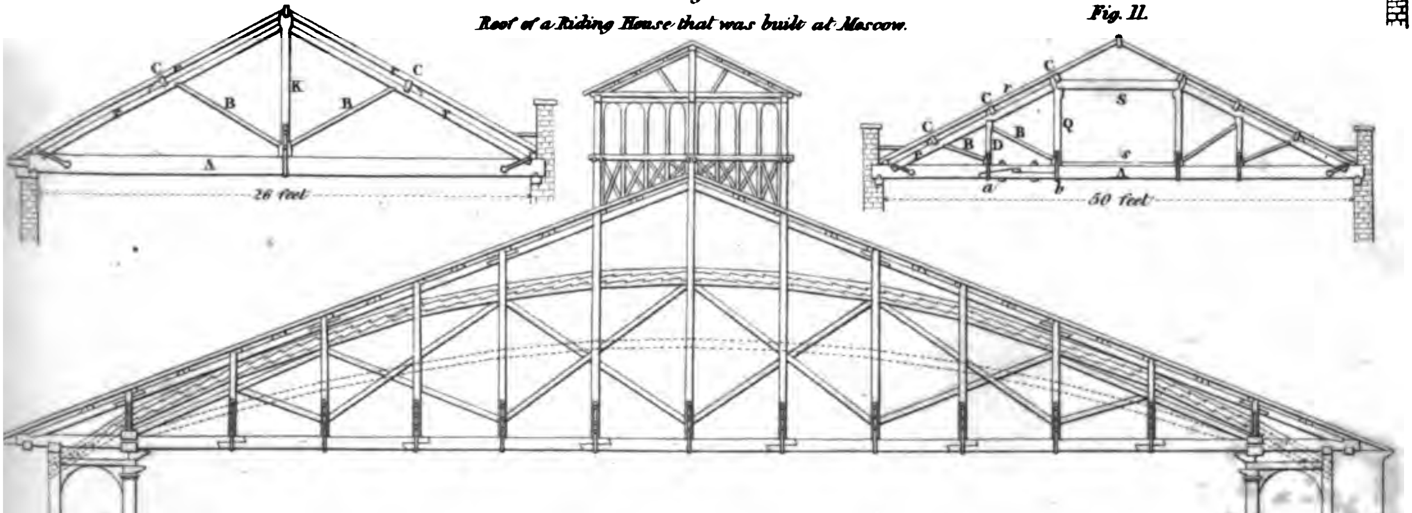

Fig. 11.

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ROPE-MAKING. PLATE CCCCLXXXII Nº I.

Fig. 2.

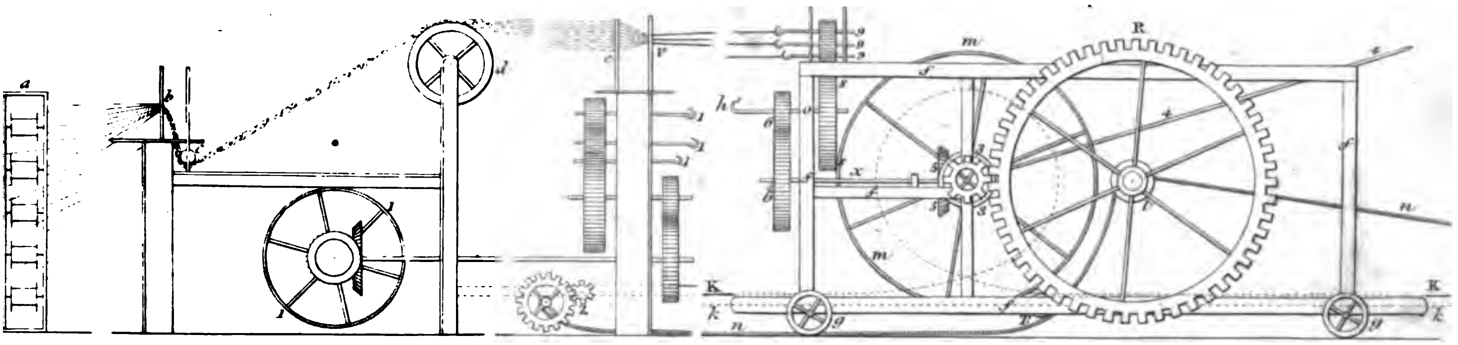
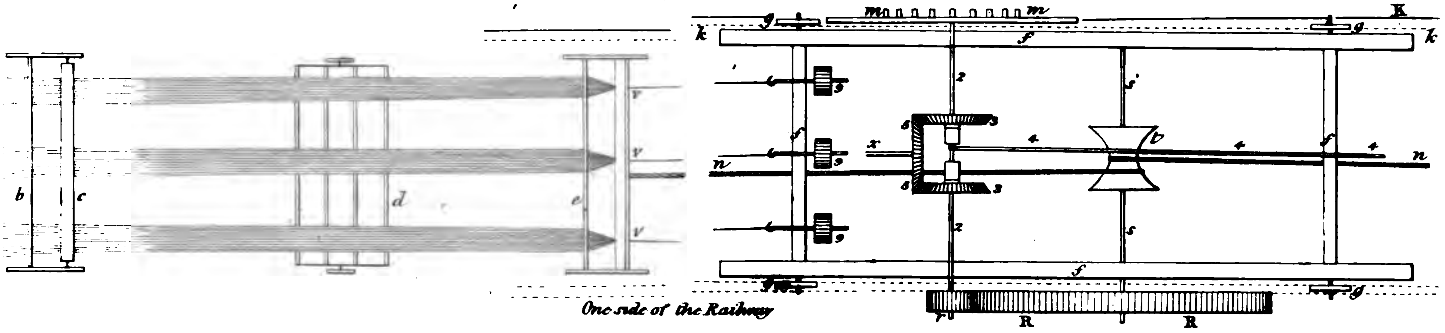


Fig. 3.



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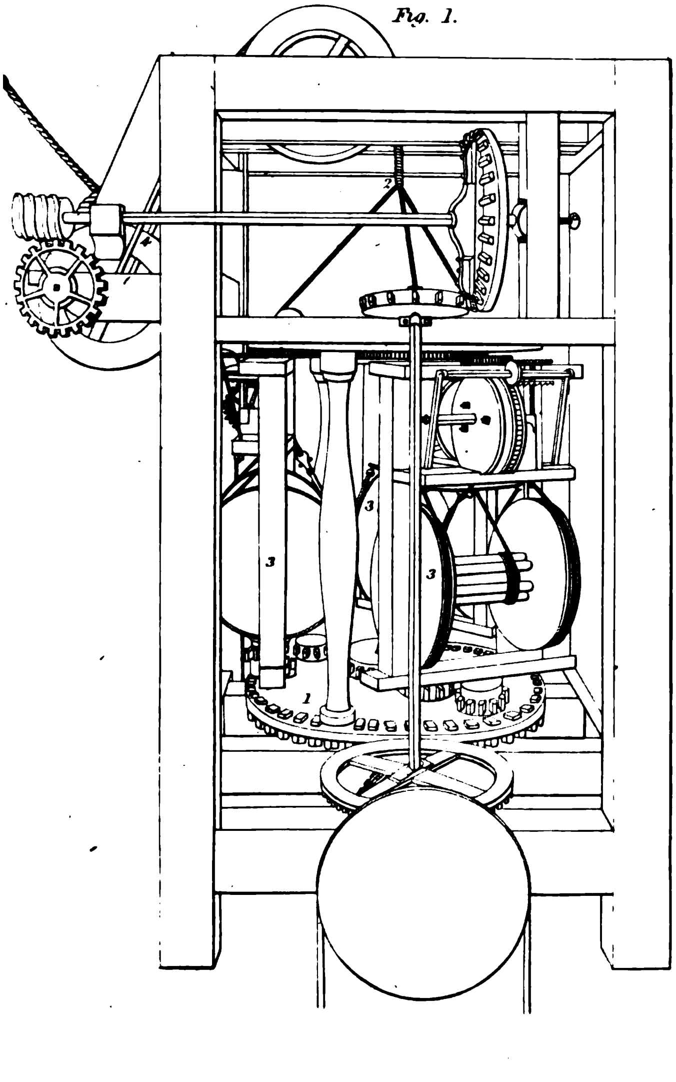

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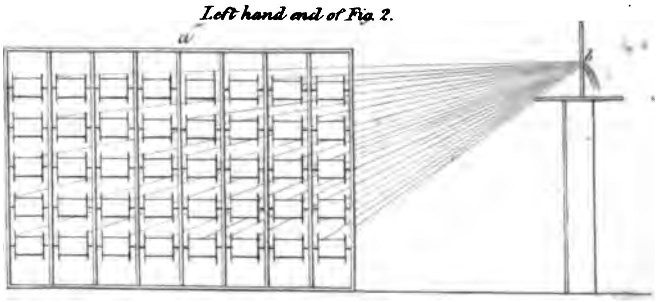
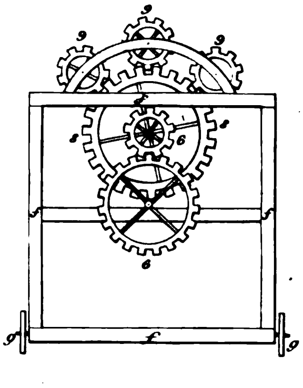


Fig. 4.



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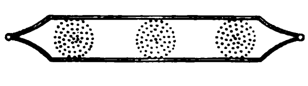


Fig. 6.

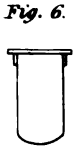
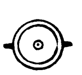


Fig. 7.



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SAWING-MACHINERY. *PLATE CCCCLXXXII No. II.*

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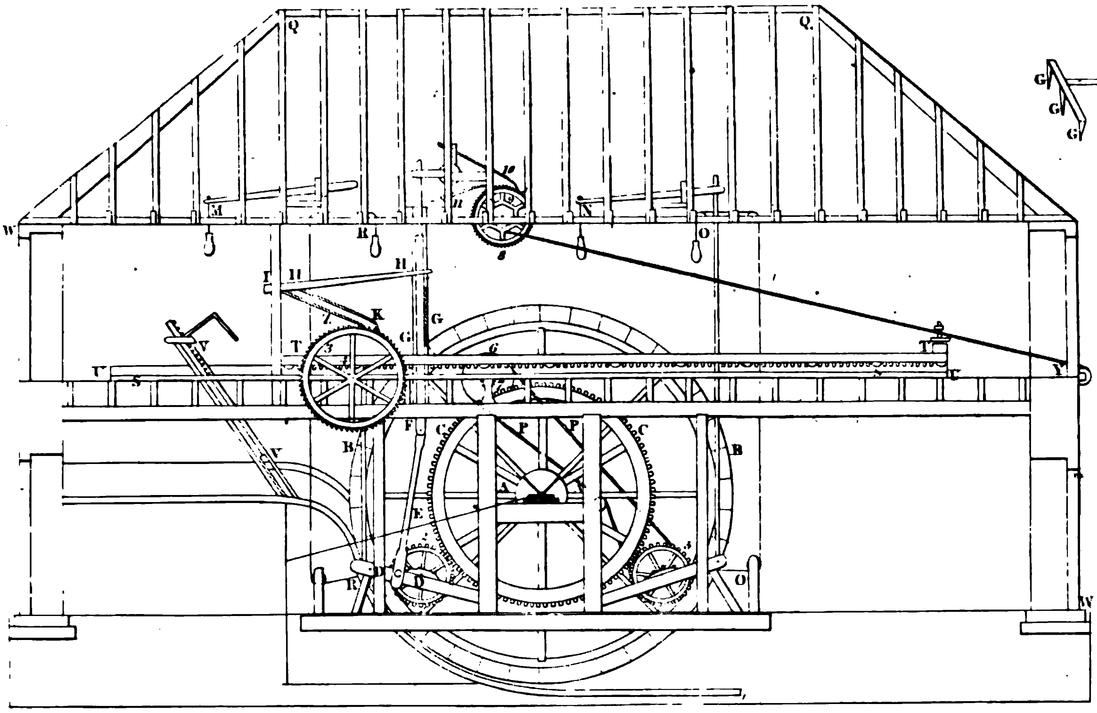

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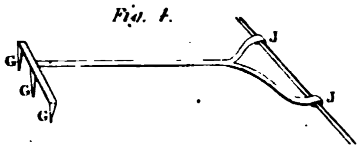

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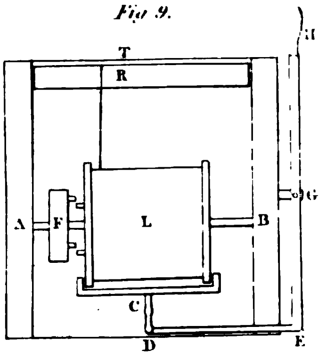

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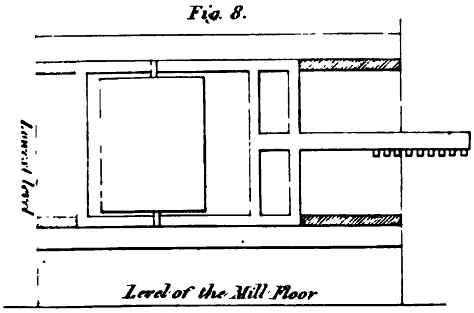

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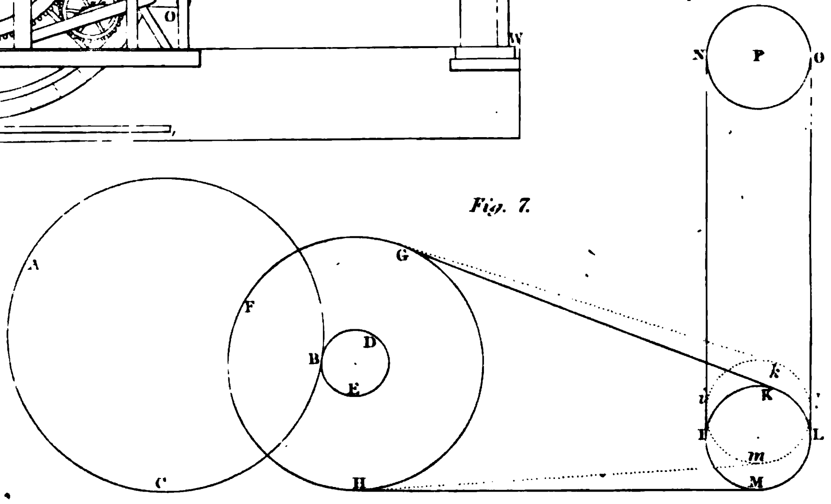

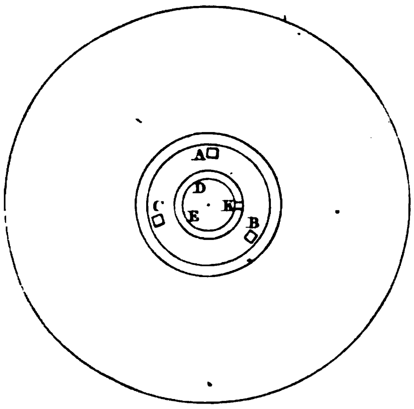

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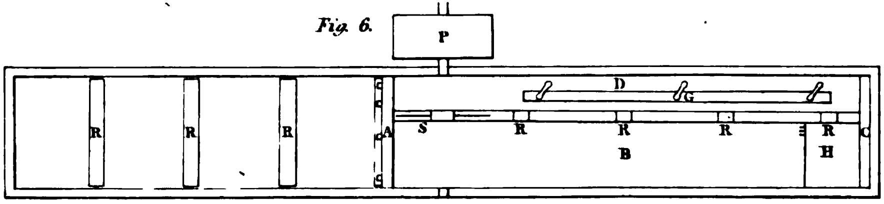

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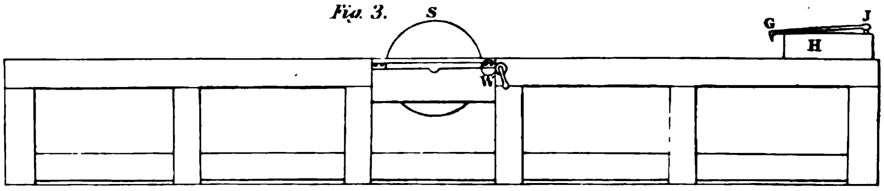

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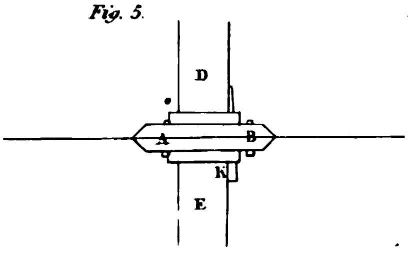

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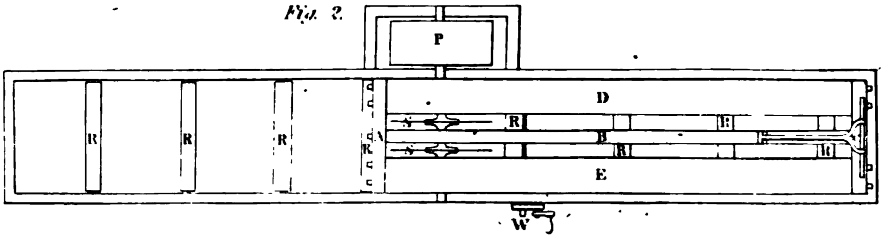

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SCIENCE. PLATE CCCCLXXXIII.

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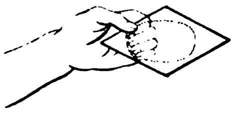

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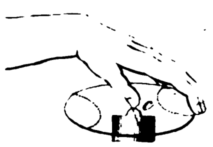

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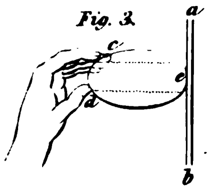

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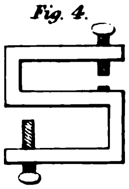

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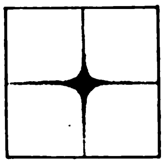

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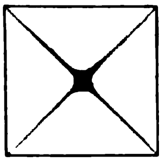

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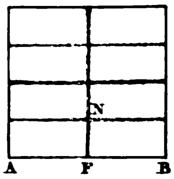

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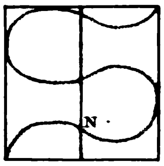

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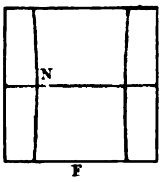

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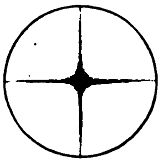

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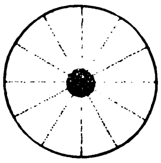

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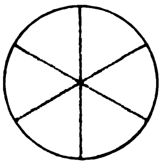

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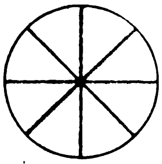

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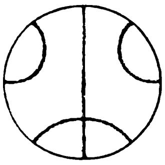

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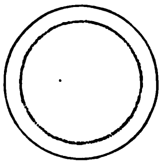

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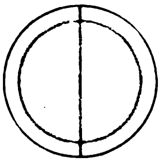

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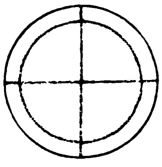

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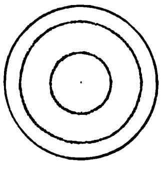

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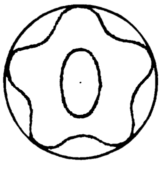

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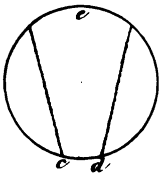

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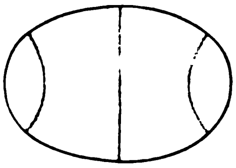

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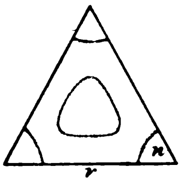

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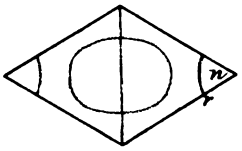

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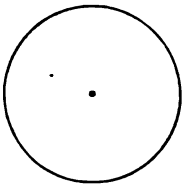

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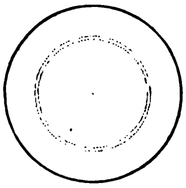

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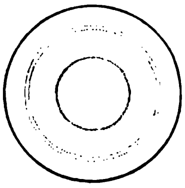

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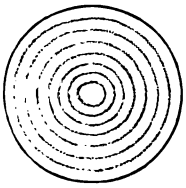

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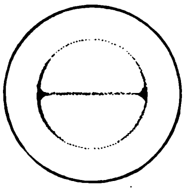

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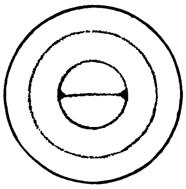

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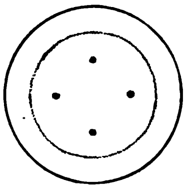

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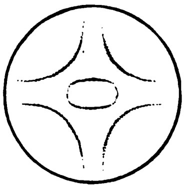

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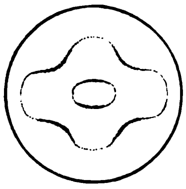

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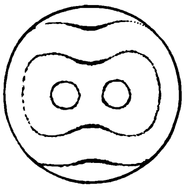

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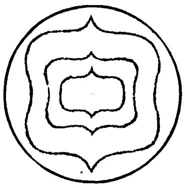

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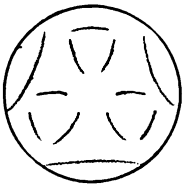

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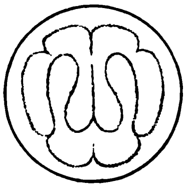

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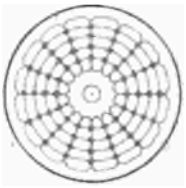

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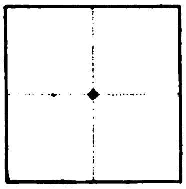

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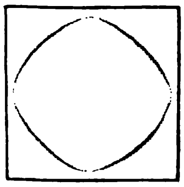

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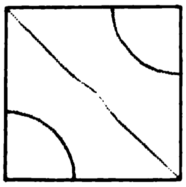

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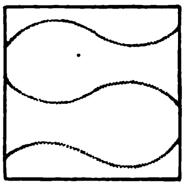

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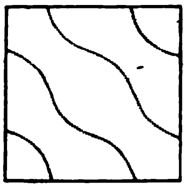

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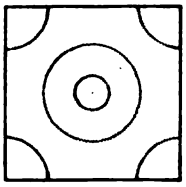

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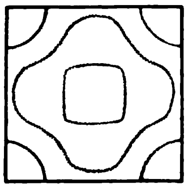

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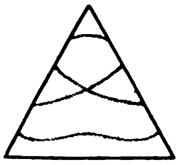

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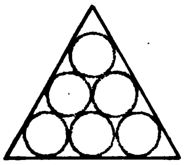

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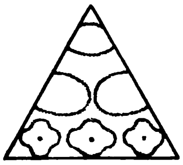

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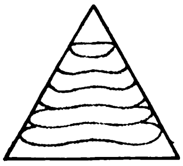

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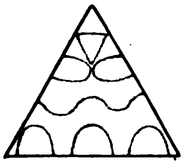

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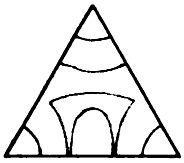

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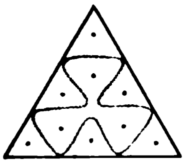

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SCIENCE. PLATE CCCCLXXXIII.

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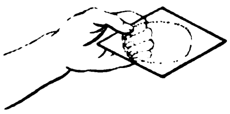

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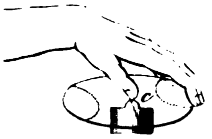

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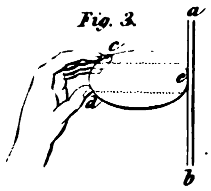

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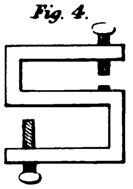

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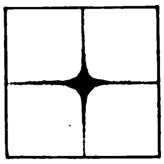

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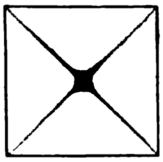

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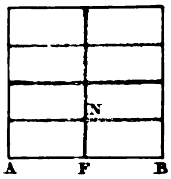

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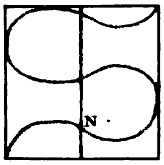

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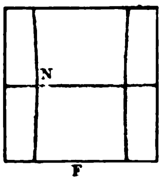

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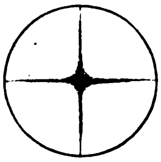

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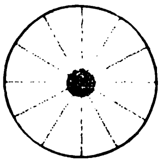

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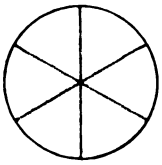

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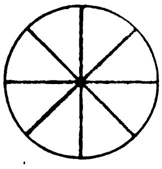

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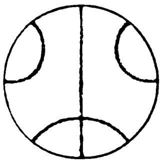

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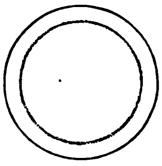

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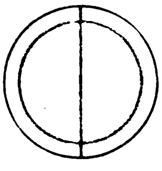

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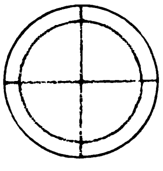

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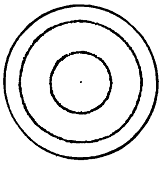

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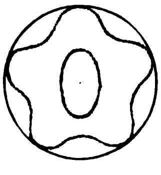

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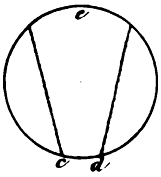

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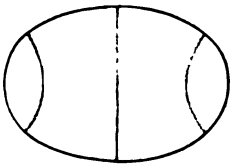

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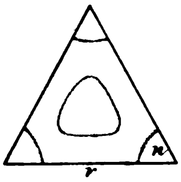

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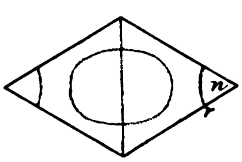

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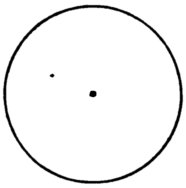

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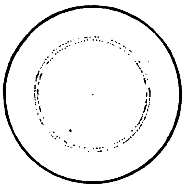

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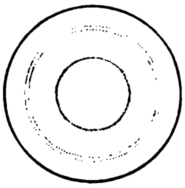

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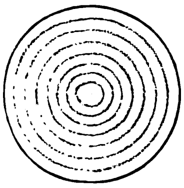

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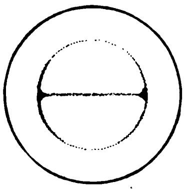

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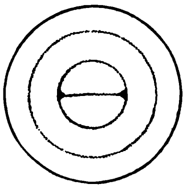

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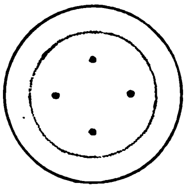

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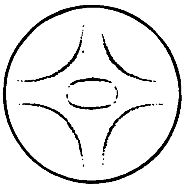

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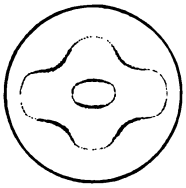

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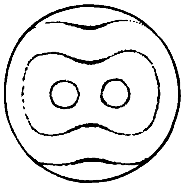

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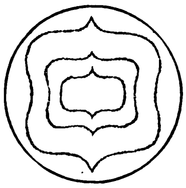

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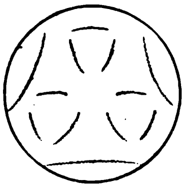

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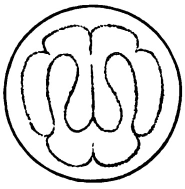

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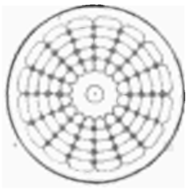

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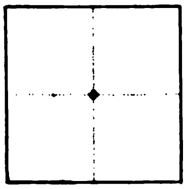

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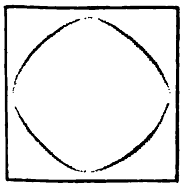

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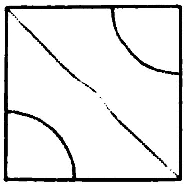

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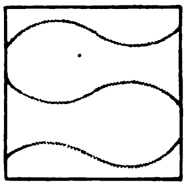

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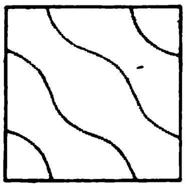

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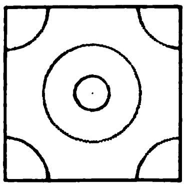

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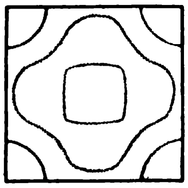

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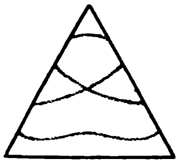

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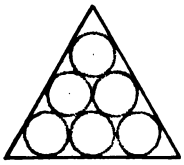

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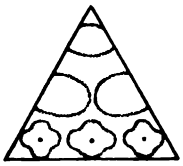

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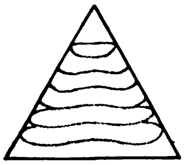

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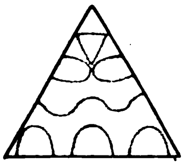

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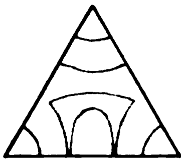

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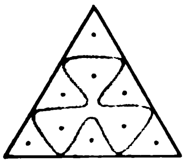

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SCIENCE. PLATE CCCCLXXXIV.

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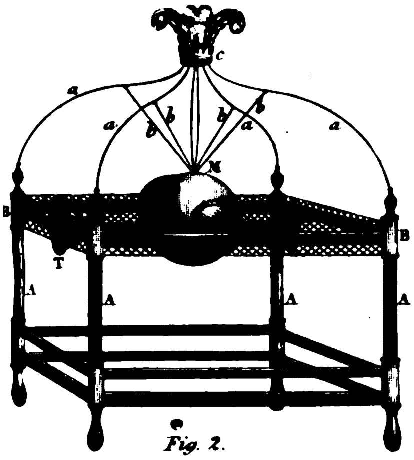

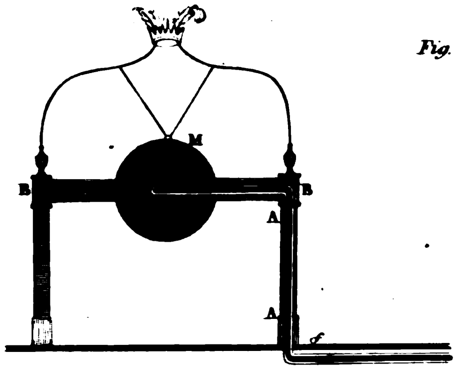

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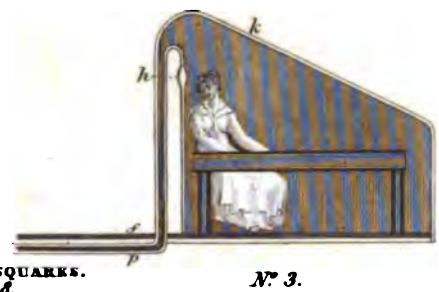

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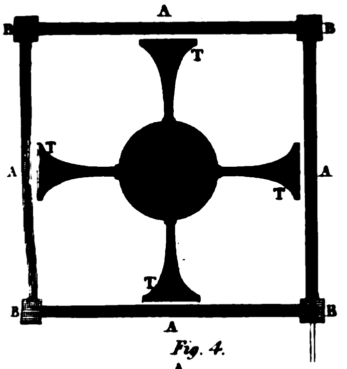

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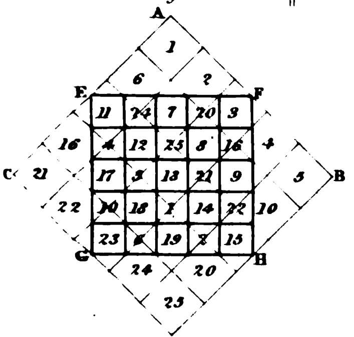


11	24	7	20	3
4	12	25	8	16
17	5	13	21	9
10	18	1	14	22
23	6	19	2	15

UNION MAGIC SQUARES.

Squares of 8.

Fig. 5. No. 1.

1	63	22	44	5	59	18	48
56	10	35	29	52	14	39	25
43	21	64	2	47	17	60	6
30	36	9	55	26	40	13	51
3	61	24	42	7	57	20	46
54	12	33	37	50	16	31	27
41	23	62	4	45	19	58	8
32	34	11	53	28	38	15	49

No. 2.

51	2	64	13	55	6	60	9
48	29	35	18	44	25	39	22
1	52	14	63	5	56	10	59
30	47	17	36	26	43	21	40
49	4	62	15	53	8	58	11
46	31	33	20	42	27	37	24
3	50	16	61	7	54	12	57
32	45	19	34	28	41	23	38

No. 3.

45	19	10	56	41	23	14	52
26	40	61	3	30	36	57	7
55	9	20	46	51	13	24	42
4	62	39	25	8	58	35	29
47	17	12	54	43	21	16	50
28	38	63	1	32	34	59	5
53	11	18	48	49	15	22	44
2	64	37	27	6	60	33	31

Squares of 12.

Fig. 6.

No. 1.

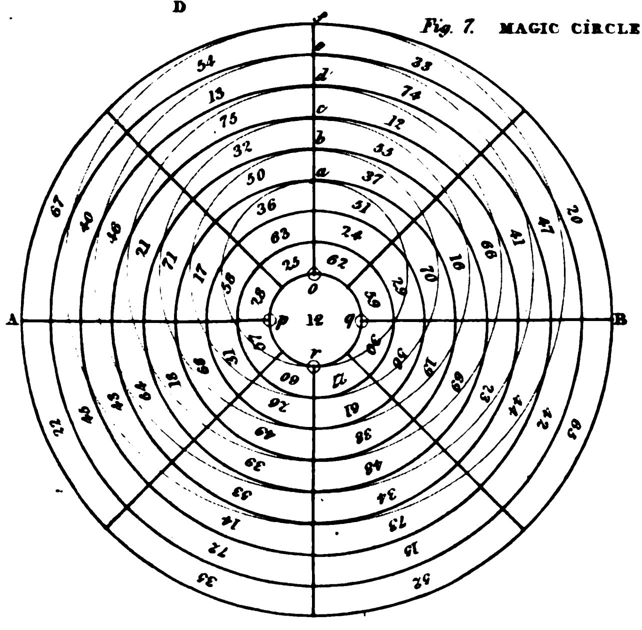
1	143	62	84	13	131	50	96	25	119	38	108
134	12	73	71	122	24	85	59	110	36	97	47
83	61	144	2	95	49	132	14	107	37	120	26
72	74	11	133	60	86	23	121	48	98	35	109
3	141	64	82	15	129	52	94	27	117	40	106
136	10	75	69	124	22	87	57	112	34	99	45
81	63	142	4	93	51	130	16	105	39	118	28
70	76	9	135	58	88	21	123	46	100	33	111
5	139	66	80	17	127	54	92	29	115	42	104
138	8	77	67	126	20	89	55	114	32	101	43
79	65	140	6	91	53	128	18	103	41	116	30
68	78	7	137	56	90	19	125	44	102	31	113

No. 2.

2	144	23	121	4	142	21	123	6	140	19	125
95	49	74	72	93	51	76	70	91	53	78	68
122	24	143	1	124	22	141	3	126	20	139	5
71	73	50	96	69	75	52	94	67	77	54	92
8	138	29	115	10	136	27	117	12	134	25	119
101	43	80	66	99	45	82	64	97	47	84	62
116	30	137	7	118	28	135	9	120	26	133	11
65	79	44	102	63	81	46	100	61	83	48	98
14	132	35	109	16	130	33	111	18	128	31	113
107	37	86	60	105	39	88	58	103	41	90	56
110	36	131	13	112	34	129	15	114	32	127	17
59	85	38	108	57	87	40	106	55	89	42	104

MAGIC CIRCLES AND SPIRALS.

Fig. 7.



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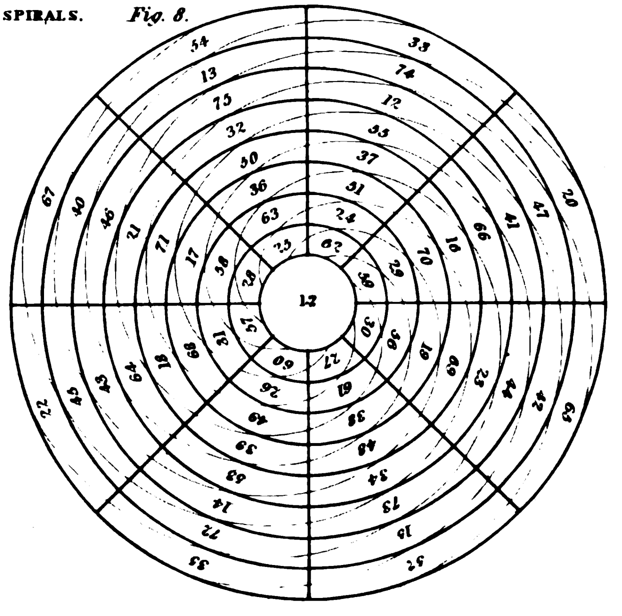

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SCIENCE. PLATE CCCCLXXXV.

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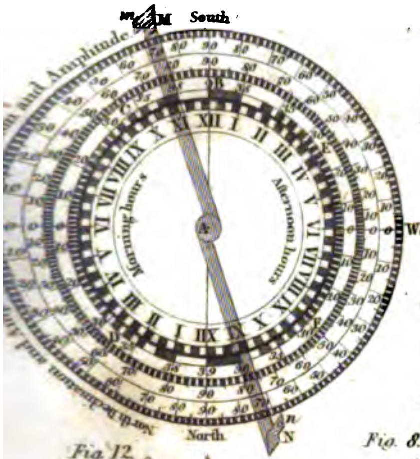

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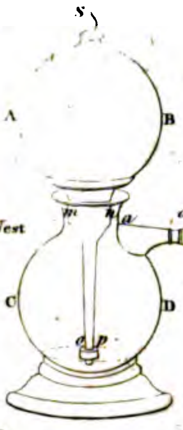

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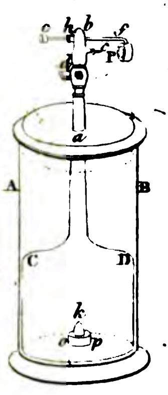

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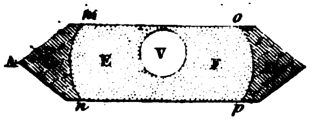

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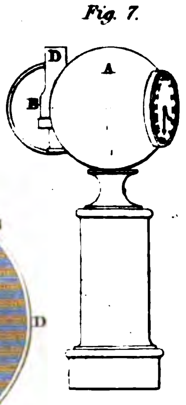

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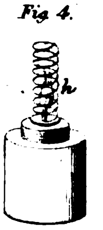

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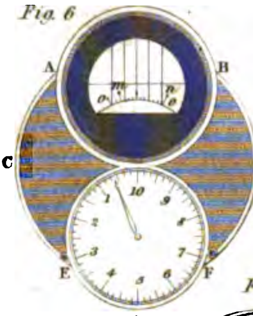

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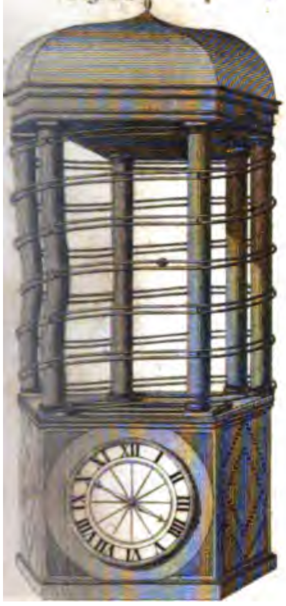

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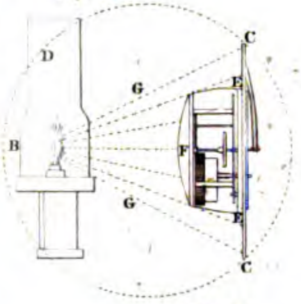

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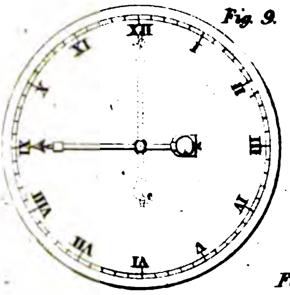

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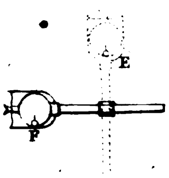

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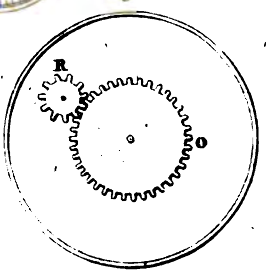

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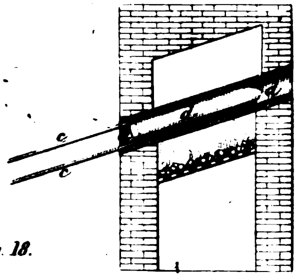

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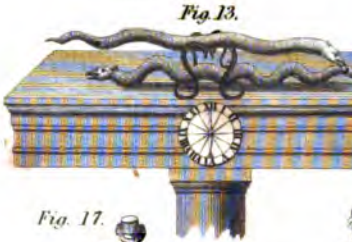

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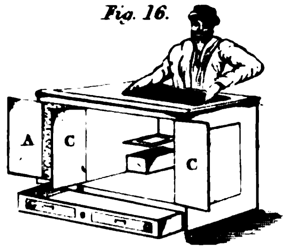

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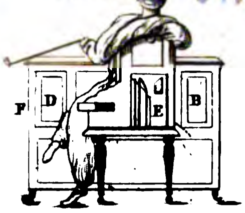

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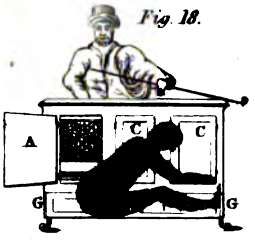

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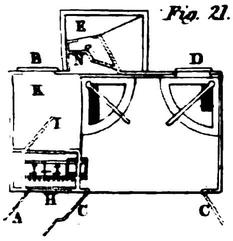

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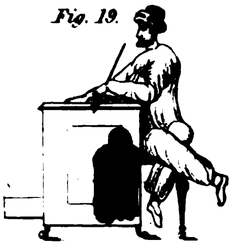

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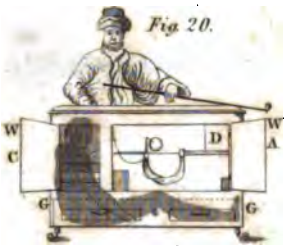

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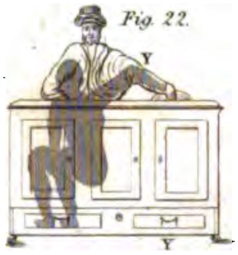

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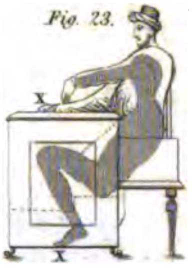

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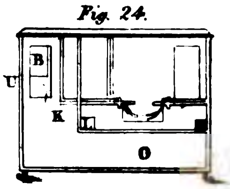

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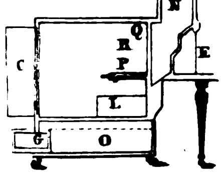

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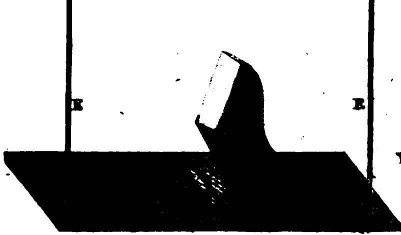

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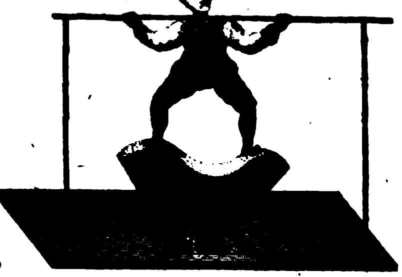

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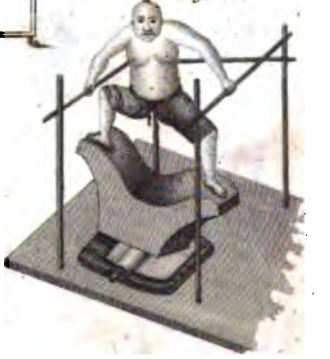

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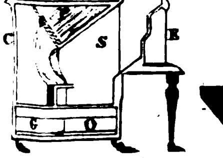

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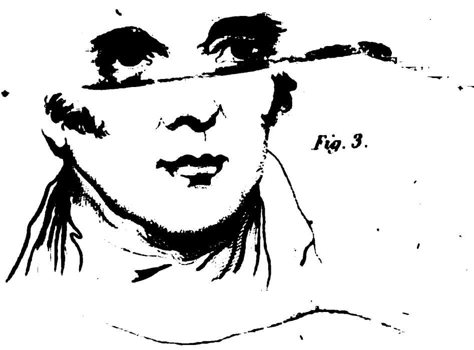

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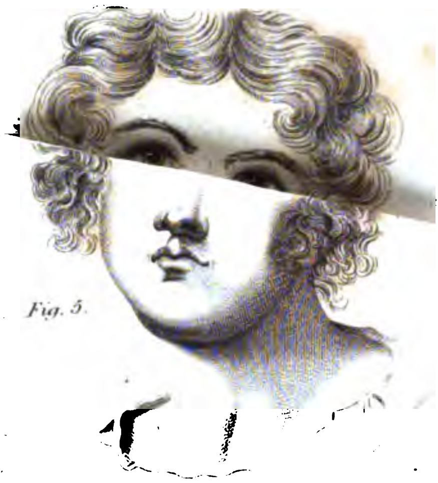

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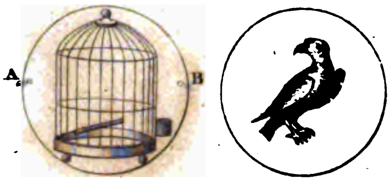

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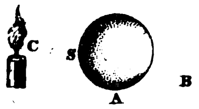

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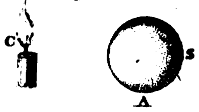

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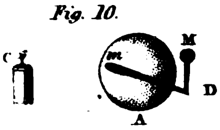

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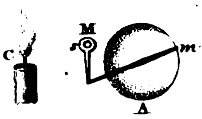

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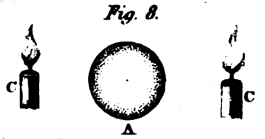

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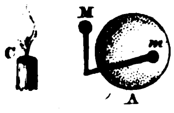

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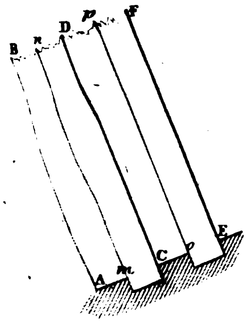

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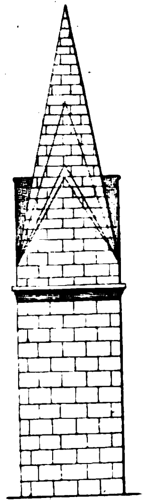

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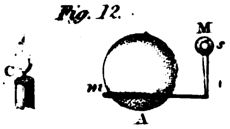

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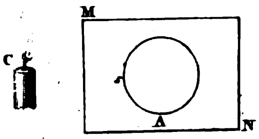

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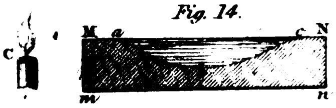

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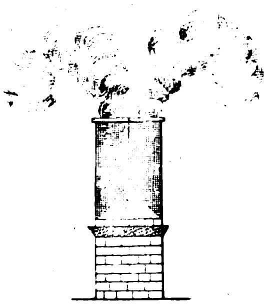

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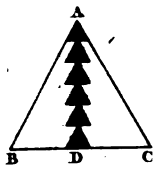

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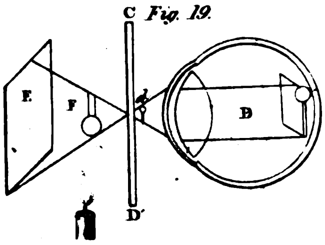

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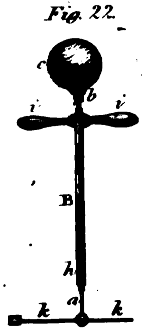

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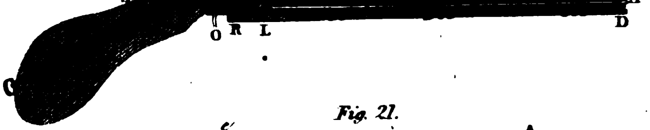

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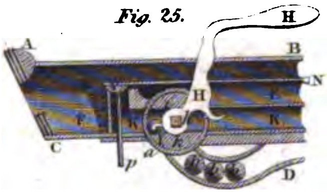

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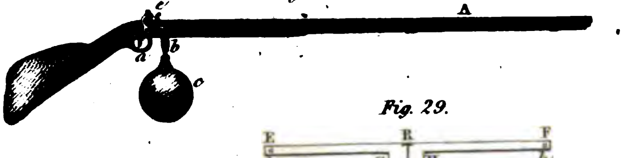

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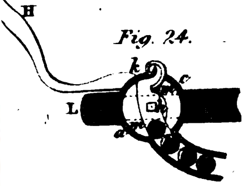

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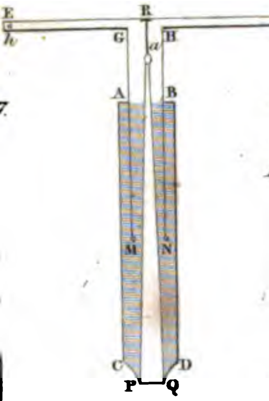

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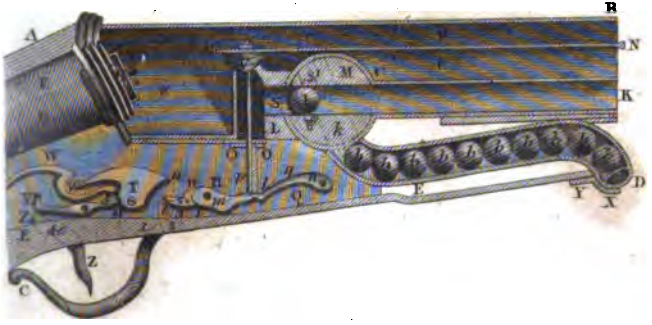

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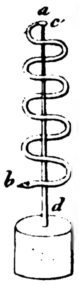

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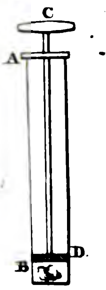

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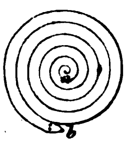

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